THE TELEGRAPHIC JOURNAL AND

ELECTRICAL REVIEW.

VOL. XXIV. JANUARY 11, 1889. No. 581.

CONTENTS:

	PAGE
Bitter Sweets	25
The Pacific Cable	26
Cotton Mill Lighting	29
The Board of Trade and Electric Lighting Licenses	29
Scandinavian Telegraph Notes	29
Regulations for the Safety of Electrical Installations	30
A Synthetic Study of Dynamo Machines (*illustrated*) (*con.*)	32
Army Telegraphy on the Continent	34
Gilbert's Patent Shackle Ball Insulator (*illustrated*)	34
The Electric Lighting of Paris	35
Electric Railways in the United States	36
Reviews:—Bellhanger's Handbook	36
Journal of Society of Teleg. Engineers and Electricians	36
Notes	36
City Notes, &c.:—Electrical Automatic Delivery Box Co.	42
Pilsen-Joel and General Electric Light Company	43
Maxim-Weston Company	43
Metropolitan Electric Supply Company	44
Traffic Receipts	44
Six Years' Practical Experience with the Edison Chemical Meter	45
Gas Mains as Electrical Conduits (*illustrated*)	46
The Economy of Electric Locomotion	47
On the Absolute Vacuum as a Non-Conductor of Electricity (*illustrated*)	47
The "Electric" Sugar Process	49
Contractors' Electrical Supplies	50
Abstracts of Published Specifications	50
Correspondence:—	
The "Maxim-Weston" and "House-to-House" Companies	51
A Protest	52
A Correction	52
Underground Mains	52
Institution of Electrical Engineers	52
A New Form of Condenser	52

BITTER SWEETS.

IT appears that for nearly five years a certain number of investors have been putting their faith in the promises of an alleged inventor to produce refined sugar by an electrical process, the secret of which he absolutely declined to disclose. The pretensions of this inventor, "Professor" Friend, were in themselves of the most preposterous character. The raw sugar was to lose all its impurities in his marvellous process, and was yet to yield precisely the same weight when refined.

People on this side of the Atlantic eagerly accepted the bait offered, and £20 shares rapidly rose to as high as 132. Now they are worthless, and one of the most astounding frauds of modern times, due entirely to "American Smartness," although possibly our young and inexperienced contemporary, the *Western Electrician*, will contest this point—exploded. A very brief recapitulation of the position of the Electric Sugar Company may be of service. It was founded in New York in 1884 with a capital of $1,000,000 in $100 shares. The invention it was formed to exploit dragged terribly, and it was not till the death of Professor Friend that really active steps were taken. Friend, no doubt, had an idea, and, possibly, also a conscience; his executors certainly had not the latter. In July the shares were somehow introduced into Liverpool. On August 25th they were £50, on the 27th £65, and since then the confident reports of the experts who watched the so-called tests drove the shares up far over £100. Those of our readers who have followed this matter during the period of time above-mentioned are aware that the Professor died some time ago, and, although dead men tell no tales, the *Daily News* correspondent, telegraphing on Friday last from New York, gives the following details of the discovery of this wretched deception:—"The suspicions of the officers of the company were aroused some days ago, when it was found that Mrs. Friend and all who had been connected with the factory had disappeared, Mrs. Friend leaving word that she had gone West. The president, treasurer, and a number of the shareholders proceeded to the factory, and invaded the secret rooms. What they discovered astounded them. There were a number of machines used in breaking cube sugar into smaller particles and in granulating coarser grades, and nothing else. There were no mysterious electrical apparatus, no wonderful cylinders, pots, or pans charged with the purifying electrical current. The investigation that was at once set on foot shows how the scheme had been worked. Not a pound of raw sugar had been refined in the factory. Quantities of refined sugar, chiefly cubes, had been purchased by the operators, and prepared in some secret spot with a chemical liquid which eliminated the ordinary impurities found in all sugars. This doctored sugar was then carted to the factory in bags purporting to contain raw sugar. The chemicals used had crystallised the cubes to a large extent, and when they were broken they had a finer appearance and quality than sugar is usually known to possess. When everything was ready, the crushers in the secret room were set in motion, and the cubes were broken into smaller particles, according to the grade desired. When the refined sugar began to come out of the shoots two floors below, all who saw it marvelled at the genius which could turn raw sugar into refined in so short a time. The scheme was cleverly worked to the very last. The shareholders and officials of the company were kept in perfect hopefulness as to the future of the process until the largest possible amount of money could be secured, and then the bubble was allowed to burst, and we are told that there is no such process as electrical sugar refining."

If our readers will turn to the REVIEW for November 2nd of last year they will see in a leaderette that we showed the whole thing to be nothing more nor less than a fraud, and it seems a great pity that the general public should be so profoundly ignorant of the opinions of technical journals upon commercial processes which involve scientific knowledge. Many people who invest their little all in some well-advertised, or, on the other hand, mysteriously secret, scheme for the loosening of

purse strings might save themselves from absolute ruin by devoting a small weekly sum to the purchase of journals which deal with subjects appealing to their investing characteristic.

The *Daily Telegraph* thus comments upon this sweet subject, and the few concluding lines will find an echo in the hearts of all electricians :—"Yes, undoubtedly the credulous ones have been 'shamefully tricked and deceived,' but we question if they are really entitled to much sympathy. They plunged in the dark ; they took no reasonable precautions to apply scientific tests to a quack, money-making mystery in an age when the 'dry light' of science beats down fiercely on all things ; yet, disdaining the didactic tone, we would only indicate the supremely ridiculous side of the whole matter. It is sad to learn that many 'professional men, ladies, clerks, shopkeepers, small manufacturers, and members of religious communities' have put not only faith but savings in this modern form of mediæval mysticism, and the one cheering ray of light in it all is that the collapse may act as a salutary tonic. When Science has a new truth to utter, or a better method of expressing an old truth, she speaks out clearly, with no uncertain voice, and never takes refuge in fortune-wrecking charlatanism. Our own regret is not so much for the dupes of the cunning Yankee as for the stain on the fair fame of the fairy Electra. She has done us glorious service, and she really must not be made *particeps criminis* in an unhappily successful fraud. Undoubtedly, she is a refining influence, but her proper subject-matter is obviously not sugar."

THE PACIFIC CABLE.

IN the month of November last the centennial meeting of the United Australian Chambers of Commerce was held in Melbourne. One of the most important matters which came under consideration was the necessity for secure and continuous means of telegraphic communication between these colonies and the Mother Country. The need for this is amply attested (if further testimony be necessary) by the numbers and standing of those who voted in favour of the amended resolution which was put by Mr. S. A. Joseph, M.L.C. (President of the Sydney Chamber of Commerce), and was passed unanimously.

In introducing the motion Mr. Joseph referred to the frequent complete interruptions of the existing cables, and pointed out that "it has become necessary to look for a duplicate communication in another direction" ; he also read a letter signed by about 150 of the most influential banks, mercantile firms, and other representative bodies, in which it was advocated that the Pacific cable scheme should be taken in hand.

Mr. J. Service, M.L.C. (late Premier of Victoria), in proposing an amendment in reference to the Pacific cable, said that "After a full consideration of the whole question he must frankly say that the work was one which should be undertaken by the Governments of Australia, Canada and England. He was certain that the undertaking would be unaccompanied with loss, and would prove a magnificent one. He would not trouble the Congress with figures, but he had satisfied himself that it would be a paying concern. If the Governments of the Colonies undertook to carry out this cable service, full consideration ought certainly to be given to the pioneers of cable communication with Australia," and went on to point out that : "Canada was entirely with the Australian Colonies in this particular project, and she, and those who advocated her interests, had themselves to bear in mind that the route proposed was the best one, taken geographically and politically. There was no dispute as to the desirability of having a cable going under the Union Jack from Australia to London ; and when this end could be secured, with commercial and geographical advantages, there should not be a moment's doubt. He would suggest that the delegates representing those Colonies which had not yet agreed to co-operate in this matter, should bring pressure to bear on their respective Governments to take immediate action. He moved that the words after 'liberally' should be struck out of the resolution with the view of inserting 'in the furtherance of this object.'"

The question as amended stands as follows :—"That this Congress heartily endorses, both on commercial and strategical grounds, the laying of a submarine telegraphic cable through the Pacific Ocean connecting Australia with the Dominion of Canada, and this with Great Britain and the continent of Europe, and trusts that every effort will be made to hasten the completion of the survey of the ocean floor. It also urges upon the various Colonial Governments the advisability of endeavouring through their Agents-General to induce the Imperial Government to co-operate promptly and liberally in the furtherance of this object."

From the foregoing we may gather that our Colonial cousins are determined that one of the most important resolutions passed by the Imperial Colonial Conference, held in London, should no longer be looked on as empty sound.

THE dense black fog which overshadowed the metropolis during last week severely tried both gas and electric lighting, but the latter came through the ordeal most successfully on the whole. We say "on the whole," because in some cases it was "tried and found wanting." Some of the installations have an awkward way of failing at critical moments, and this happened in a few instances. On the other hand, the clear penetrating beams of the arc lamps overcame the darkness with great success, notably in those large railway stations and at the junctions and complicated signal stations where this light has been adopted. Electricity thus made a strong point in its own favour, but powerful as it is, it cannot entirely defeat a London fog, and so at one time the workmen on board some steamers in the Thames which are lighted by electricity were idle, because the fog was too black and too dense even for the electric light. When we saw belated pedestrians and cabmen groping about with illusory feeble oil lamps and candle lanterns, we regretted all the more

that as yet no cheap and effective hand electric lamp has been produced. Inventors and manufacturers will do well to turn their attention in this direction in view of future visitations of Egyptian darkness.

NOW that winter seems to have really set in and snow will probably not be long in coming, it will be well for electrical engineers, especially those of the Post Office and the telephone companies, to examine their overhead wires. It is easy to recall the damage wrought by these wires when on past occasions (notably two years ago) heavy falls of snow have dragged them down. Since then the number has greatly increased, and with previous experience to guide those responsible for these wires, a repetition of breakages such as have injured buildings and people and endangered public safety, ought to be rendered almost impossible. In connection with this subject it is worth noting that a correspondent signing himself "W." writes to the *Times* to draw attention to the fact that "overhead wires conveying electrical energy of a very high potential are being fixed with great rapidity," and to urge the importance of steps being taken by Parliament to regulate these operations and prevent accidents which not only cause injury and damage, but are detrimental to electric lighting generally.

THE subject of electric lighting has been turned to account in a new direction. Captain James, a well-known and successful Army "coach," is a candidate in South Kensington for the London County Council, and in his address he touches on the prolific question of monopolies. Referring to the existing monopolies in gas and water supplies, he urges that this private company system should be guarded against where possible, and in this connection he alludes specially to electric lighting. Skilfully avoiding committing himself either way as to the adoption of this luminant, he observes that "advantageous as its introduction *may be*," the mistake committed in regard to gas and water must not be repeated. This is a very wise attitude no doubt, and in view of the recent agitation on the subject in Kensington, it may seem proper to raise the point in an electioneering address; but the gallant captain forgets that the County Councils will have no control over the matter. Electric lighting is one of the questions expressly withheld from the purview of the coming local Parliaments. With roads, rates, bridges, coroners, prisons, lunatic asylums and many other matters they may deal, but not with electric lighting. That was left in the hands of the Board of Trade, but now, as will be seen elsewhere, it is to be dealt with only by Parliament. Captain James therefore will not score much by the point he seeks to make; on the contrary, he may lose something in votes, for he takes neither side in the controversy in Kensington, and so both parties may hold aloof from him.

THE credulous and unsuspecting Robert Roberts referred to as the largest English shareholder in the Electric Sugar Refining Company, is the leading spirit of an obscure and superstitious religious sect known as the Christadelphians. He is also the editor of a monthly publication known by the name of *The Christadelphian*. Mr. Roberts and his sect see in every scientific discovery the fulfilment of some Hebraic prophecy, and in a recent number of his journal the electric dog-cart of the Sultan was described as being foretold in the vision of Ezekiel. We don't know whether the *dènouement* in America will shake Mr. Roberts's faith in ancient prophecy, but we should imagine it will considerably modify his belief in human nature and secret processes. The very fact of the whole affair being kept a secret ought to have aroused suspicion, and though we are sorry for the victimised shareholders we feel that their disappointment has been merited by their meddling in things they know nothing about.

Modern Light and Heat says:—Mr. J. E. H. Gordon, a well known English author of several standard works on electricity and magnetism, who once estimated that the direct current systems were no more expensive to instal and more economical in maintenance than alternating current systems of distributing electric currents; and, in his "Treatise on Electric Lighting," described the only desirable storage battery as a duplicate set of dynamos, engines and boilers with steam up and fires banked, has at last experienced a change of opinion, and will now perhaps find material to expand his five line chapter on "Central Station Lighting."

IT is stated in trans-Atlantic circles that the reason for the acceptance of the Westinghouse Electric Company's tender to furnish a 25,000 light plant for the Sardinia Street station, London, was not merely one of price, but the successful operation of this system in more than a hundred central stations in the United States, which warranted the rejection of experimental local systems, as the directors of the Metropolitan Electric Light Company who are building this station felt the absolute necessity of taking no chance of failure or of trusting to any experimental work in this their first enterprise. If this version is correct nothing further need be said, although it is generally supposed here that other agencies were at work. It can hardly be said though that Mr. Mordey's transformer system is an experimental one.

"TRUTH" speaks in the following terms respecting the Parliamentary prospects of the autocrat of the cable ring:—"Sir John Pender is a gentleman who has devoted himself to ocean telegraphy in its relation to directorships, and who makes an exceedingly good income out of it. Twice he applied to the Liberal Government to make him a knight or a baronet, and twice Mr. Gladstone declined to accede to his request, on the latter occasion—when this prize director sent in a statement of what he had done for the world in general—observing that he appeared already to have reaped his reward. The unknighted director, like the crushed worm, will turn. Mr. Pender became a Liberal Unionist, and by persistent applications he managed to get himself knighted. In politics he is an absolute nonentity. He sat for some time in the House as a sort of nominee of the Duke of Sutherland, with whom he had had monetary transactions. I believe that he has not the remotest chance of getting in for the Govan Division, and that he merely comes forward to show his gratitude for the knighthood which has been conferred upon him by Lord Salisbury."

WE have had occasion more than once to deplore the intrusion, where an electric lighting firm is in negotiation for the lighting of a particular town or district, of

a second firm or company offering either better terms or a more advantageous system. One or two notorious cases are no doubt in the minds of our readers; but we thought that with the disappearance from the electric lighting circle of the principal offender in this respect, we should probably hear no more of such tactics. Not so, however. As is generally known, Mr. Massingham, by virtue of that perseverance and determination which has distinguished his campaign in the West, has succeeded in obtaining the approval of the authorities at Bath for his designs in regard to the lighting of that city, and matters have progressed so far that he has definitely announced that the electric light will be in operation by March 25th. Yet at a meeting last week of the Surveying Committee a letter was read from the House-to-House Electric Light Company, applying for the sanction of the Corporation to an application to the Board of Trade for a seven years' licence, and drawing attention to the superior advantages in the shape of experience of district lighting by means of underground mains, which the company could offer. It was rightly said at the meeting at which the letter was read that, after arranging with one company, they should not entertain proposals from another. For some reason which it is not easy to divine, the matter was referred to the Electric Light Committee, instead of being immediately dismissed from further consideration; but as the opponents of the notion of interference moved the reference, we suppose the application is sure to meet the fate it deserves. There is no rule or law to govern such attempts to cut out a rival who has had the fortune to be first in the field excepting the canons of good taste and professional etiquette; we are sorry to see that these latter are not regarded in all cases as obligatory.

WRITING to the morning papers upon the decision of the Board of Trade not to grant licences for lighting large and important areas in London, Mr. R. Hammond observes:—"From this announcement it will appear that the statement published in the press is incorrect, and that the Board of Trade is actuated to-day by the same policy as that which it enunciated in its letter of the 17th of August, 1883—*i.e.*, that a licence is the form of tenure under the Electric Lighting Act properly applicable to small areas—whereas large areas can only be properly dealt with by means of Provisional Orders. The question, therefore, which the Board of Trade and the local authorities have now to decide is whether the time has arrived when in the public interest the metropolis shall be dealt with by the allotment of large areas to certain electric light companies under a 42 years' tenure, or whether it would not be a more prudent course, in the present stage of the industry, to insist that those companies that are applying for this permanent form of privilege should, in lieu thereof, be granted licences for a short number of years and for limited areas, in order that the merit of their pretensions may be tested by a probational period of working." Mr. Hammond then goes on to state a number of reasons why it may be advisable for the local authorities and the Board of Trade to grant licences for limited periods and for limited areas in the metropolis in preference to Provisional Orders giving a 42 years' tenure.

TO one of these Mr. Erskine, the secretary of the Kensington and Knightsbridge Electric Lighting Company, replies as follows:—"The chief point to which I desire to call your attention is the inaccuracy of Mr. Hammond's suggestion that no district lighting has yet been so satisfactory in the metropolis as to warrant the apportionment of the metropolitan area by means of provisional orders. My company has been supplying the electric light to residences in the vicinity of Kensington Court for the last two years. Throughout the whole of that time there has only been one partial stoppage and lowering of the illuminating power, which lasted for less than one hour and a half (between 4 and 6 p.m.), and occurred at a time when necessary changes were being made with a view to the extension of the supply. With this single exception the light has been supplied by meter throughout the whole period in question day and night without intermission, and with the same regularity as gas. Moreover, the mains of my company are laid entirely underground. I submit, therefore, that the experience of my company is sufficient to show that the time has now come when provisional orders may be granted with due regard to the interest of the public, and I would point out, moreover, that it cannot be expected that the light will be supplied on any greatly increased scale except under the protection which a provisional order alone can give. It is for this reason that my company are now applying for a provisional order in Kensington and Knightsbridge, and I am surprised that Mr. Hammond should put forward reasons against the granting of provisional orders, seeing that the House-to-House Company, which he represents, is making a similar application."

LORD CRAWFORD also goes for Mr. Hammond in a very lengthy communication, and thus concludes:—"Mr. Hammond now asks the public to believe that, so far from 21 years being insufficient, the industry may be expected to work satisfactorily under the seven years' tenure afforded by a licence. Feeling sure that I shall carry with me the assent of every other representative of the trade, I conclude by asserting that if the Board of Trade should decide not to grant a longer tenure to eletric lighting undertakers than is afforded by a licence, the distribution of current in London under Parliamentary authority will be checked as effectively for the future as it has been during the past six years."

AT a meeting of the Barnet Local Board on the 1st inst., the report of the surveyor was to the effect that the lights generally were not so good as in September, some of them not being any better than an ordinary gas lamp. This entirely bears out the statements we have recently made on the strength of our own observation; but nevertheless, the result of the meeting was that the notice to terminate the contract with Messrs. Joel & Co. was withdrawn and the account due to them paid. One of the members of the board expressed his belief that if the contractors were given sufficient time every satisfaction would be given, and now that the board seems to have got the worst of a bad bargain, we hope that such faith in Messrs. Joel and Co. will be justified.

THE *Builder* believes that practical electricity is a subject which the architect of the future will have to study, and that it ought to form part of an architectural student's curriculum.

COTTON MILL LIGHTING.

AN important installation of the electric light has been made at the Lomeshaye Mills, Nelson (Lancashire), belonging to Messrs. Wm. Ecroyd & Sons, where over 1,000 hands are employed in spinning and weaving. The engine and dynamos are fixed in the old mill near the boiler house, a position which is central to the extensive works lighted. The engine has been supplied by Messrs. Tangye Bros., Limited, Birmingham, and is of over 200 indicated horse-power. High pressure cylinder is 16 inches and low pressure 28 inches, stroke 30 inches, pressure 100 lbs., speed 90 revolutions per minute. There are two Edison-Hopkinson dynamos of 110 volts and 590 ampères each. There are four brushes to each rocking arm, each separately adjustable with spring forward thrust and hold-off clutch. The dynamos are provided with resistance coils for governing the amount of current in field magnets to allow for variation in the number of lamps. The electrical efficiency of those dynamos is 95 per cent., and they are driven by 15-inch link belts. In the various rooms altogether there are 1,260 lamps, of which 200 are 16 candle-power, 600 of 25 and 460 of 32 candle-power.

There are altogether five circuits, three of which are connected to one of the dynamos and two to the other. On the first dynamo is a portion of the mill, the old shed (containing 300 looms) and one-half of the south shed (which contains over 1,000 looms). On the other dynamo is the circuit, which includes the north shed (containing over 600 looms), and the other half of the south shed, and also the overtime circuit (which includes the offices, cloth looking department, sizing rooms, and parts of the mill where overtime is sometimes worked). The arrangement of the lamps in the sheds is not uniform, but has been made with a view to securing equal distribution of light. For instance, sets of four looms—generally wide ones, on which important work is made—have a lamp allotted to each pair of looms. In sets of six a lamp is alternately provided for three and two looms; whilst in sets of eight a 32 candle-power lamp is placed in the centre of the block, and a 25-candle one over the inner side of each outside pair. By this arrangement the weaver is never in his, or her, own light. The bulk of the lamps in the sheds are of 25-candle illuminating power. Over each lamp, which can be disconnected from the pendant wire in an instant, as it is in a small bayonet socket, is a porcelain shade 6 inches in diameter. This acts both as a reflector and a diffuser of light, and the roof and floor of the building are thus proportionately lighted. In the winding, beaming, and other rooms the lamps are arranged over the machinery to light it to the best advantage, and the flexibility of the drop wire enables the tackler, in attending the jacquards, to place the lamp where he requires it. In the cloth-looking rooms the porcelain shades are 12 inches in diameter.

The wire and cables of high insulation were supplied by Messrs. Walter T. Glover & Co., of Salford, and the whole of the work was carried out under the direction of Mr. Williamson, managing director of the Manchester Edison-Swan Company. This is one of the most important installations ever carried out in this district, and is another of those prominent instances where gas is gradually giving way to electricity.

THE BOARD OF TRADE AND ELECTRIC LIGHTING LICENCES.

A VERY important notification has been issued by the Board of Trade affecting electric lighting licences. By the Act of 1882 it was provided that "The Board of Trade may from time to time license any local authority as defined by this Act, or any company or person, to supply electricity under this Act for any public or private purposes within any area," subject to the consent having been obtained of *every* local authority having jurisdiction within the area affected; and to certain other conditions. The 4th clause also enacted that "The Board of Trade may from time to time, by *provisional order* authorise any local authority, company or person to supply electricity for any public or private purposes" but "*without requiring* such consents as are required to the granting of a licence," subject to the other conditions respecting licences, and to due notice having been given to the local authority by the applicants of the intended application. These provisions have not been altered by the subsequent Acts, and upon this principle the Board of Trade has hitherto acted. It is now, however, intimated that the Board has decided to refuse all the applications made for electric lighting licences for large areas in London. But the Board will continue its past procedure in other respects, and in future all applications for leave to supply the light will have to be by means of provisional orders, which must receive Parliamentary sanction to become valid. In view of this change of method, it may be of use to recall the stipulations respecting provisional orders. Following the condition already recited as to notice, it is enacted that (2) "The Board of Trade may submit to Parliament for confirmation any provisional order granted by it in pursuance of this Act, but any such order shall be of no force unless and until it is confirmed by Act of Parliament. (3) If, while the Bill confirming any such order is pending in either House of Parliament, a petition is presented against any order comprised therein, the Bill, so far as it relates to such order, may be referred to a Select Committee, and the petitioner shall be allowed to appear and oppose, as in the case of private Bills. (4) Any Act confirming any provisional order granted in pursuance of this Act may on the application of the undertakers thereby authorised to supply electricity, be repealed, altered or amended by any subsequent provisional order granted by the Board of Trade and confirmed by Parliament."

Why the Board of Trade has come to this determination does not appear, but it may be due to the fierce competition carried on by several companies seeking to supply the same areas; and possibly the scramble recently disclosed in Kensington may have finally brought about this result.

SCANDINAVIAN TELEGRAPH NOTES.

HAVING in two previous articles dealt with the progress of the telephone and the electric light in Scandinavia, we conclude with some particulars of the extension of the telegraphs and their working in that peninsula.

At present the telegraph net of Sweden comprises 8,345 kilometres of cable and 21,300 kilometres of connecting wires, with 944 telegraph stations, of which 179 belong to the State Telegraph Board, 234 to the State Railways, 27 to private railway companies, and 4 to private persons. Naturally, the best inhabited provinces of the country are most favoured in respect of this agency of communication. During the past financial year, 1,242,372 telegrams were transmitted, of which 540,000 paid ones were inland and 650,000 foreign. The number of press telegrams was 25,000, 7,119 being foreign. The foreign correspondence was greatest with Great Britain, viz., 25·8 per cent., Germany following with 24 per cent., Denmark with 15·8, and Norway with 9·6 per cent. The average number of words in the foreign messages was 11·7, which shows that the number is still declining ever since the introduction of the word tariff system. The gross receipts of the telegraphs for the financial year amounted to £71,500, which is a decrease since the past year of £550, or 0·8 per cent. The decrease falls wholly on the inland correspondence—with 3·2 per cent., the foreign ones having increased with 1·7 per cent. The average receipts from the inland messages was 1 kr. 12 öre (1s. 2½d.), and from the foreign ones 0 kr. 92 öre (11¾d.); 2,358 messages, or 0·3 per cent., were undelivered through being insuf-

ficiently addressed. The permanent male staff consists of 4 directors, 15 superintendents, cashiers and comptrollers, and 134 operators, making a total of 203; whilst the female staff numbers 177 lady operators. In addition there were employed 80 male and 200 female assistants, and 250 telegram boys. The expenditure for the year amounted to £69,800, leaving a deficit on the working of £700. For the current year the deficit was estimated at about the same amount.

It may be of interest to mention that in Sweden all lady telegraphists are trained and graduate at an official school of telegraphy under the supervision of the State Telegraph Board, the course of study extending over three months.

Although a deficit has, as stated, been estimated for the current financial year, it has been found that, in consequence of a reduction in charges on telegrams introduced last year, the receipts of the first nine months of 1888 have increased so considerably that there is more likely to be a surplus. In consequence of this unexpected result, and taking into consideration the results attending the sixpenny telegram reduction in this country, the Swedish Government has decided upon a further reduction of charges still from the commencement of this year, the charge for inland messages being now 50 öre (6½d.) for 10 words with 5 öre extra for every additional word. It is believed that this reduction will further swell the telegraph revenue.

The Swedish Telegraph Board has issued an excellent telegraphic map of Sweden for the convenience of the *employés*, on which is denoted every possible information relating to the telegraph and telephone service of that country.

The telephone is making rapid progress in Norway, most towns of consequence having now one or two central stations. The central station at Christiania at present transmits about 8,000 to 10,000 messages a day, and has 1,700 subscribers. Arrangements are also being made for connecting the central towns of Norway with the capital. The town most distant from Christiania connected by telephone is Vormsund, a distance of 100 miles.

The returns of the State telegraphs for the first half-year of 1887—the first since the reduction in the telegram tax took place—show some curious results, the number of messages transmitted being respectively 417,000 during the same period of 1886, 406,000 in 1887, and 586,000 in 1888, whilst the receipts were respectively £32,000, £29,500, and £32,000. It is anticipated that the reduction in charges will have greatly increased the Norwegian telegraph revenue of last year.

REGULATIONS FOR THE SAFETY OF ELECTRICAL INSTALLATIONS.*

A. Apparatus for the Production, Storage, and Transformation of the Electric Current.

1. The installation of appliances for these purposes must take place only in premises in which there are no explosive or readily combustible materials.

2. If the difference of potential between any two points of the source of the current, or of the conductors leading to the appliances for the storage or the transformation of the current, exceeds 150 volts in alternating currents or 300 volts in continuous currents, such source or conductor must be insulated from the ground.

Alternating current machines must under all circumstances be insulated from the ground.

An insulation is sufficient if it consists of a wooden support of 100 millimetres in thickness, protected against the penetration of moisture by a coating of asphalte or tar, or by soaking in linseed oil. The apparatus must be fixed upon the insulating support in such a manner that any contact of their metallic parts with bodies which possess a lower resistance than wood may be avoided.

If such insulation of a machine from the ground is impracticable (*e.g.*, in case of steam light machines), the ground all about the machine must be covered with a highly insulating material—wood, caoutchouc, glass, &c.—so that no person can reach the machine unless he stands on this material.

In case of high tension or alternating currents, if there is no special lock-up room for the source of the current and the appliances necessary for its storage and transformation it must be placed only in rooms exclusively restricted to the persons engaged in its management.

3. If during such production, storage, or transformation injurious gases are evolved, the apparatus must be placed in separate rooms, not to be used for any other purpose, and fitted with draft-hoods of suitable dimensions leading directly into the open air.

B. Conductors.

4. All the conductors or connections required to convey the current between the generators and the apparatus for the storage or transformation of the current, or to the places where it is to be utilised, must be of such dimensions that the rise of temperature of their surface produced by the passage of the current shall not exceed the external temperature by more than 68° Fahr.

In case of conductors of copper with a conductivity of at least 80 per cent. of that of pure copper, and with sections not exceeding 100 square millimetres, the greatest demand permissible is 3 ampères per square centimetre, if insulated, and 4 ampères per square centimetre in case of uncovered wires.

5. The use of wires of less than 1 millimetre is admissible only in cables of several strands.

6. The above regulations do not apply to fusible safety connections and rheostats, but in such cases all those parts of the conductor in which much heat may be evolved must be insulated from their surroundings in such a manner that they cannot come in contact with inflammable materials.

7. Rheostats which may become strongly heated, and switches in which the formation of sparks is possible, must not be placed in rooms where readily combustible or explosive gases occur, except in air-tight recipients.

8. The insulating resistance of a conductive net, as regards the earth or parts of the same circuit where differences of tension occur, must be at least

$$5{,}000\ \frac{E}{J}\ \text{ohm},$$

E being the maximum difference of tension in volts between the points in question, and J the strength of the current in ampères.

In cases where in consequence of great moisture in the surrounding atmosphere (breweries, dye works, electric tramways, &c.), the above resistance cannot be attained, a lower insulation may suffice if, *a*, the conductor is carried exclusively over insulators, and in such a manner that there is absolutely no risk of fire in consequence of derivation or extension of the conductor and, *b*, if in tensions of more than 150 volts in alternating currents, or 300 volts in continuous currents, any accidental contact of persons with insufficiently insulated parts of the circuit is excluded.

9. In rooms where there are acids or gases which might attack the insulating material or the conductor itself, proper protection against these influences must be provided. The insulation of such conductors must be tested yearly, and, at the same time the condition of the conductors themselves must be examined, as in (4).

10. The use of non-insulated conductors is admissible only in the open air, and at heights of not less than 3½ metres from the ground. Rheostats are excepted, but they must be protected as in (4).

In spacious covered sheds, halls, large workshops, &c., bare conductors may be used if at elevations not less than 4 metres, supported on porcelain insulators, and perfectly secured against contact with combustible or metallic substances.

* Issued by the Electrotechnical Association of Vienna.

11. In all cases where naked conductors might possibly come in contact with telegraph or telephone wires, or with gas and water piping, or other metallic articles, the parts in question must be insulated.

12. Naked conductors, between which there is a difference of tension, must be carried at a distance from each other of at least 15 centimetres horizontally, and at least 30 centimetres vertically. Such conductors must be laid in accordance with the rules for State telegraphic lines.

13. An insulated wire, *i.e.*, one protected along its whole length with non-conductive material, must be carried at a distance of not less than 40 millimetres from wires running parallel to it, measured from metal to metal.

If the difference of potential between any two points of the conductor exceeds 150 volts, the distance must be increased by at least 10 millimetres for every additional 50 volts or fractions of the same.

14. We may except from this rule particularly well insulated wires, if the insulation resistance of the wire, after lying for 24 hours in water, is at least 2,000 × E ohm per kilometre as compared with the water. Here E signifies the maximum difference of tension in the circuit, expressed in volts.

15. All conductors conveyed in moist rooms or in damp places must be stretched upon insulators, unless the insulation of the circuit itself is in accordance with (14).

16. The conductors are, if possible, always to be made accessible, and should never run under floors or in slits in a wall.

17. In passing conductors through walls or floors, the wires must be enclosed in pipes of a very good insulating material, which should also, as far as possible, protect the insulation against injuries from without. The conditions given below under (26) must also be observed. Protective pipes carried through flooring should project at least 20 millimetres above it.

18. Those parts of the conductor which are liable to occasional changes of places (conducting cables for portable lamps) should be especially well insulated, and should further have an outer casing of very resisting material. Such branch conductors should further be protected by fusible cut-outs.

19. To secure conductors, whether insulated or naked, to their supports by means of metal clamps or other conductors is not permissible.

20. The use of the earth or of metal substances, such as gas and water pipes, iron girders, pillars, or other metal parts of a building is not permissible.

21. Where a destruction of the coating may arise from external action (friction, &c.), a protective, resistant insulation must be adopted.

22. All connections to conductors must be soldered on, except in case of removable appliances.

23. Resin and acids must not be used in soldering the connections, but only a soldering salt containing no free acids, using a well tinned soldering iron. In cables of fine wires a soldering lamp must not be used.

24. In clamp connections for currents of more than 100 ampères, as a security against displacement, all the ends of the conductors must be made clean before soldering, and if possible they should be tinned.

In connecting together insulated conductors, only so much of the insulation must be removed as is absolutely necessary. All the points of junction should then be insulated afresh very carefully.

Care should be taken that the resistance of transition is smaller at the junction than in other parts of the conductor.

25. Sharp bends of the wires or cables must be avoided, and care must be taken that the conductor is nowhere exposed to mechanical injury.

26. In case of tensions of more than 500 volts for continuous and 200 volts for alternating currents, the conductors should be laid so as not to be accessible to meddlers. Such conductors should never be placed under floorings or in grooves in the wall.

Such conductors must be carried at the height of 2½ metres above flat roofs and at ½ metre above gable roofs.

27. Primary conductors for secondary generators are, if possible, not to be taken into the interior of buildings; if this cannot be avoided they should be sufficiently protected.

In the transformation of the tension by means of transformers or accumulators, if in the primary conductors the difference of potential between any two points exceeds 500 volts in continuous currents and 200 volts in alternating currents, then, in addition to the precautions under (4) care must be taken that as soon as the difference of tension between the two poles of the secondary circuit, or between one pole of this circuit and the earth exceeds the normal tension by 50 per cent., the connection of the conductor with the transformers or the accumulators is cut off automatically.

28. At crossing points the conductors must be particularly well secured, and in all conductors not in accordance with (14) the conductors where they cross must be kept apart by some solid material of a good insulating character.

The insulating plate must have the length of its sides at least twice as great as the distance of the conductors given under (13).

But instead, it may suffice if one of the crossing conductors is enclosed in a thoroughly insulating pipe, protected against any breakage. Or the crossing may be made in the form of an arch, observing the distances given under (13), and taking care that any approximation or contact of the conductors is rendered impossible.

29. Crossings of conductors with gas or water-pipes, &c., are to be treated like crossings of two conductors.

30. If the conductors are secured with clamps, these must not be more than 1 metre apart from each other, and in curves the intervals must be smaller. When the conductors lead to screwed connections, the nearest clamp must not be at a greater distance than 100 millimetres.

31. At central stations indicators of earth connection should be arranged by means of which the insulation of the conductive net is to be tested at least twice in the 24 hours, and if the working is not continuous immediately after the beginning and shortly before the end of the day's work.

C. Safety Arrangements.

35. In all conductors in which currents of more than 5 ampères may occur self-acting interrupters (*e.g.*, fusible cut-outs) must be introduced which prevent the strength of the current in any part of the conductor from exceeding the double of the normal demand as laid down in (4).

If these appliances interrupt the circuit they must act upon such a length that an arc cannot be formed.

33. Current breakers and switches must be introduced in very dry places or in water-tight boxes, preferably in a vertical position and easily accessible.

34. All points of contact must be kept in a state of metallic cleanness.

35. In conductors in which the strongest current that can occur under normal circumstances exceeds 30 ampères, self-acting current breakers must be applied at both poles; with less strengths it is sufficient if the breaker is applied at one pole, but in this case all the interrupters of a closed conductive net must be applied at the same pole.

36. In systems with several conductors where the strength of the current exceeds 36 ampères self-acting current breakers must be applied to all the conductors. For weaker currents this may be omitted in one conductor, but in this case also all the current breakers of a closed conductive net must be applied at the same poles.

37. In introducing self-acting current breakers at points where there occurs a change in the section of the conductor it must be applied as closely as possible to the point where the alteration takes place.

38. Every self-acting current interrupter must bear a mark on which may be seen the normal strength of the current for which it is constructed.

39. All self-acting interrupters must be so placed that no contact of the point of interruption or of the fused matter with combustible matter is possible.

In rooms where inflammable or explosive gases occur the point of interruption must be enclosed gas tight.

If mercury interrupters are used, the surface of the mercury must be kept bright, and care must be taken that there is no escape of mercurial vapours.

40. Every main point where a current is given off (in particular in front of every house where a central station is in use) must be provided with interrupters which can be worked by hand. These must be placed upon insulating supports, readily accessible for police and firemen, and legibly marked "current" and "small current."

In single installations it must also be possible to break off rapidly and certainly the connection between the source of the current, &c., and all the conductors.

41. In short circuit switches a double contact must first close the outer circuit, and then interrupt the conductor to the point where the current is given off.

42. At points where a contact with telegraph or telephone wires is possible, self-acting interrupters must be introduced before and behind the dangerous places.

43. The conductors should be so conveyed as not to disturb existing telegraph or telephone lines.

D. Illuminants.

44. In all cases where tensions of above 200 volts in alternating currents and above 500 volts in continuous currents may occur, uncovered metallic portions of the illuminants (frames of glow lamps, supports of arc lamps) must not lie in the circuit.

45. Where lamps are suspended, their weight must not be supported by the connecting screws. If fine wires are used in cables for portable lamps, the ends should be soldered before being secured with screws.

46. Illuminants in or on which conductors are led must be insulated from gas pipes, &c.

47. The tube of illuminants through which the conductors are introduced must be smooth within, free from sharp corners, grit and splinters. If acids have been used in soldering them, they must be carefully washed and cleaned before the wires are introduced.

48. To prevent the entrance of water (by condensation) the tubes of the illuminants must be closed watertight at their junction with the conductors.

49. Frames with removers for glow lamps can only be applied for portable lamps when they have a handle at least 100 millimetres in length.

50. Arc lamps must not be used in places where there are explosives or combustible gases. Glow lamps must be placed in safety cases.

51. In rooms containing combustibles, protective bells, spun round with wire gauze, must be used for arc lamps, and beneath the carbons metal plates must be fixed to catch the ashes.

52. If a contact of the arc lamps with the combustibles is possible, the protective bells must be kept closed.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

(*Continued from page* 694, *Vol. XXIII.*)

V.—MAGNETIC FIELDS IN PRACTICE—(*continued*).

17. *Waste Magnetic Field.*—In paragraph 15 was given an expression connecting the induction in a magnetic circuit with the ampère turns required to produce it. It was then assumed that in both the iron and air parts of the circuit the lines of force were confined within certain specified areas, though it was stated that owing to their straying beyond these limits the ampère turns given by the formulæ were liable in practice to considerable modification.

In figs. 63 and 64 are sketched the elevation and plan of a dynamo machine having a single horse-shoe magnet and drum armature, the magnetising coils being omitted for simplicity. We have here a magnetic circuit made up of a yoke piece, A, two limbs, B, B, two air gaps, C, C, and an armature core, D. In former considerations we have assumed the cross section of the

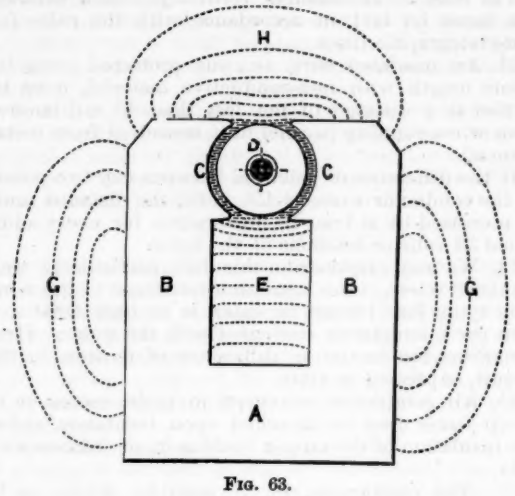


FIG. 63.

magnetic circuit to be confined to the cross sections of the yoke and limbs, to the cross sections of the air gaps extended beyond the measured polar surfaces by an amount equal to ·8 of the length of each gap and to the cross section of the armature core. These assumptions require some correction.

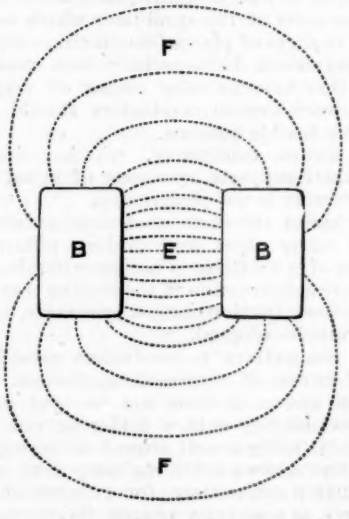


FIG. 64.

It must be remembered that it is in the armature core that we require the induction. We wish a certain number of lines of force to be enclosed by each of the rotating loops twice per revolution; and the whole of the magnetic system—field-magnet and magnetising coils—is but a means to the end of getting through the core, and consequently through the loops a sufficient number of lines of force. It was on the assumption that all the lines induced in the magnet limbs passed through the armature core that the truth of the expression for the ampère turns depended. This expression has now to be corrected.

Our filling up as far as possible with iron the path we desire the induction to take through the machine does not prevent a diffusion of the lines throughout surrounding space, many of them, as a matter of fact, straying outside the armature core and constituting a

waste field quite useless to us. Instead of taking the path we wish them to take they select a great many different routes for themselves, and we have therefore to create a total field of which we can utilise but a portion. The way in which the lines of force stray in the space surrounding the machine is shown in figs. 63 and 64, their paths being indicated by the dotted lines. Of the total lines induced in the magnet limbs, B, B, the majority find their way through the armature core, but there is a certain portion which passes from limb to limb without taking this path. These stray, as shown, between the adjacent and remote sides of the magnets as at E and F, between the poles and the yoke as at G, and between the poles as at H. The direction of the lines of force is always in the path of least resistance, and the ratio of the field which can be utilised to the waste field must depend, therefore, upon the resistances offered respectively by the path we wish the lines to take and the alternative path outside the armature which we wish them to avoid. We may really consider the area of diffusion as an air gap of very large cross section, though of considerable length, and our aim should be to make the air gap proper as short as possible and to extend its cross section that the resistance to induction in the proper path of the lines may be a minimum, while, on the other hand, the distance apart of the surfaces between which there is a tendency of the lines to stray must be increased to make the resistance in the alternative path as great as possible.

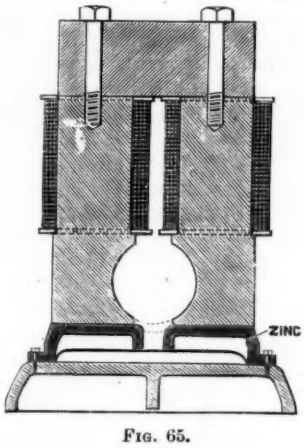


FIG. 65.

A predetermination of the number of waste lines or of the path taken by them is most difficult, if not impossible. Unfortunately, the proportion of lines wasted depends on a number of circumstances which are not generally capable of accurate expression, and our best way is, therefore, to compute the stray lines by the help of such observations as have already been made, where the waste field has been actually ascertained. In the Edison-Hopkinson dynamo, Drs. Hopkinson found that 75·76 per cent. of the total lines induced were utilised in the armature core, the waste field being constituted by the remaining 24·24 per cent. In this machine, a cross section of which is shown in fig. 65, the single horseshoe magnet is inverted, the poles resting on a slab of zinc, which intervenes between them and a cast iron bedplate. Out of the 24·24 per cent. loss, 10·3 was accounted for by the lines straying from pole to pole through the zinc slab and across the iron bed. In the Manchester dynamo, the carcase of which was shown in fig. 55 (page 692, Vol. XXIII.), the waste field was found by the same experimenters to be 33 per cent. of the total lines induced, only 67 per cent. being, therefore, utilised, and passing through the section of the ring armature. From these examples it is possible, in the absence of actual measurement, to make a few rough deductions as to the probable waste field in different types of machines.

In the magnet shown in figs. 46 and 47 (page 628, Vol. XXIII.), there is manifestly no straying of the lines between the adjacent horns, N_1 N_1, since these are all of the same polarity. In such a magnetic system there is consequently no waste field. There is a certain extension of the air gap, due to the spreading of the lines at C C, which makes its cross-section somewhat greater than that of the polar faces. The amount of spreading depends primarily on the length of the gap, but it implies no waste, since all the lines created between a pair of poles are enclosed by each successive coil of the armature as the magnet rotates. Due to this extension, the magnetising force required for the induction through the air gap is slightly less than if we assumed the lines as confined to an area equal to that of the polar faces.

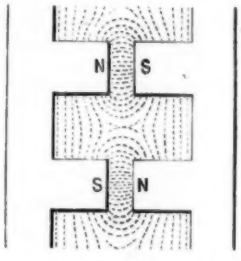


FIG. 66.

In the magnetic system shown in fig. 49 the waste field is considerable. Here the lines of force run between the adjacent magnet cores as shown in fig. 66, and only about 50 per cent. of the total lines induced find their way through the armature coils. The proportion of the lines wasted depends, as has been stated, on the resistance to the induction offered respectively by the paths the lines are desired to take and avoid and evidently if the gap between the polar faces is increased the waste field is increased at the same time. The above figure has been obtained by Mr. W. E. Sumpner for a Ferranti machine in which the length of the air gaps is reduced to a small amount, and it may, therefore, be considered as representing fairly the usual amount of waste in this type of field. If ν be the ratio of the total induction through the magnets to the induction directly utilisable for the production of E.M.F., its value here is $\nu = 2$. In the older alternating current machines of Siemens the waste must have been considerably greater.

In the single horseshoe machine, fig. 51, we have passing between the magnet limbs a waste field like that shown in fig. 64. Let us assume that the machine has no iron bedplate, but is bolted down by a couple of angle pieces attached to the yoke while the armature is supported by two gun metal brackets attached to the poles. In this case we may compute the waste lines at 16 per cent. or so of the total lines induced, ν being about 1·17. In the Edison-Hopkinson machine the waste field was 24·24 per cent., but 10·3 per cent. was accounted for by the proximity of the bedplate to the poles. There ν was 1·32. Here where there is no bedplate the total lines induced in the magnets for a given flow through the armature will be less, and the percentage utilised about 84. The assumption of the waste field as 16 per cent. for this class of machine will be found pretty near the truth.

If by placing iron near the magnets, the lines of the waste field are enabled to take a short cut there results an increase in their number due to the iron shortening the path they have to take through air. Let the magnet in fig. 51 be mounted on a cast iron bedplate with a cast iron standard raised on each side of it for the support of the armature. An elevation and section of this arrangement are shown in fig. 67. Here the waste lines leave one magnet limb and straying to the iron standards pass across them returning to the other limb as shown. The stray lines will be increased by the presence of these standards, but the waste from this cause will not be nearly so great as that due to the proximity of the bed to the poles in the Edison-Hopkinson machine. In single horseshoe machines when the poles are at the top, fig. 67, the waste field for normal designs is probably about 20 per cent. of the

total lines of force induced in the magnet limbs and $\nu = 1{\cdot}25$.

Coming to the double horseshoe magnet, fig. 52 (page 692, Vol. XXIII.), we should expect a considerable increase in the waste field, because of the increased

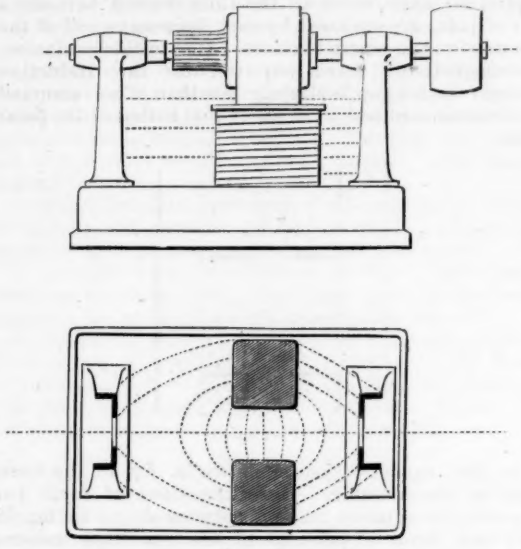


FIG. 67.

magnet surface as compared with single horseshoe fields. It is difficult to say in the absence of measurement what the waste field really is, but if we imagine that the magnet limbs have in each case the same length we shall probably be very near the mark in assuming that the waste field in the double magnet type, other things being equal, is 50 per cent. more than in single magnet machines. If the magnet, fig. 52, were fitted with a drum armature carried by gun metal brackets and supported by feet fastened directly under the yokes, we might expect the waste field to be something like 22 per cent. of the total lines induced, the value of ν being about 1·3. It will be observed that though the waste field is increased by 50 per cent. the total percentage of lines lost is only increased by a small amount, ν rising from 1·17 to 1·3. This means that other things being equal for the double horseshoe, there must be about 11 per cent. more lines of force induced in the field magnets if the same amount of induction is required in the armature.

[Errata.—In last article Vol. XXIII., page 694, first column, seventh line from the top, read N_1 *a* S_1 instead of N *a* S; twelfth line from the top read *a* to N_1 instead of *a* to N; and thirteenth line, read N_1 and *c* instead of N and *c*.]

(*To be continued.*)

ARMY TELEGRAPHY ON THE CONTINENT.

THE French *Journal Officiel* has just published a decree modifying some articles of that of July 23rd, 1884, bearing on the organisation of the military telegraph service. According to the new dispositions, a general officer, designated by the Minister of War, is to take charge of the annual inspection of the different services of military telegraphy. On the other hand, the Minister of Finance can prescribe periodical inspections, having for their object instruction from a technical point of view. In case of mobilisation, the Administration of Posts and Telegraphs has to gather together at the points designated the staff it has to furnish. The adoption of these measures constitutes a real progress in the organisation of the French military telegraphy. This service in war plays a more important part than is generally imagined, and to give an idea of this we may put forward the following details :—

At the beginning of the Franco-German war, Prussia mobilised five sections of field telegraphy and three of other descriptions. The first connected the general quarters with their corps; the second placed these general quarters in communication with the fixed lines in the rear. Bavaria and Wurtemburg had also both formed a section of field telegraphy. In addition, two new sections were sent in the month of October to the field of operations, and three field directions were created at Nancy, Epernay, and Lagny. At the end of the war the military telegraphy of the Germans possessed 407 stations, and attained a development of 10,830 kilometres. Paris was surrounded by a circuit of 150 kilometres of telegraphic lines. These lines, of which there were two, were each composed of four aerial wires placed out of the way of the French projectiles. These few retrospective particulars are sufficient to show the importance of this service, considering especially that telegraphy in time of war becomes more prominent in proportion with the increase in the size of armies and of the theatre of operations.

GILBERT'S PATENT SHACKLE BALL INSULATOR.

AT present, when improved insulation is required at terminal poles, the usual custom is to terminate the wires on insulators of the ordinary pattern, though of a stout and special make; this system, whilst electrically right, is mechanically imperfect, as there is great danger of the arm splitting and breaking; and, moreover, the insulator gets pulled over from its vertical position, and looks unsightly.

FIG. 2.

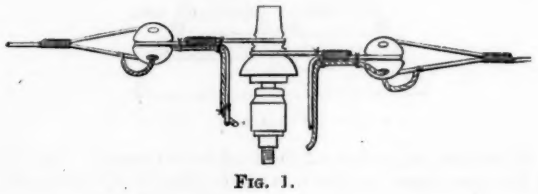
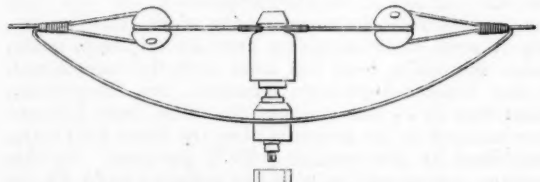


FIG. 1.

FIG. 3.



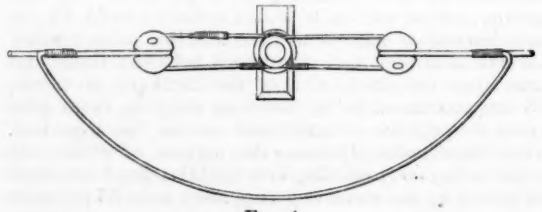


FIG. 4.

By adopting the arrangement shown by fig. 1, Mr. Gilbert claims that, for an intermediate station, the cost would be much less than the ordinary Bright's shackle, whilst the superiority of the insulation would be most marked, there being three distinct breaks for the current in place of two. We hear that the idea is being adopted in America.

It may be mentioned that since the introduction of these balls on the Highland Railway 2½ years ago, the improvement in the insulation and the working of the wires is most satisfactory, and therefore it is the intention to employ them to a much larger extent, so that in a little time the old and leaky double shackles will not exist.

Figs. 2, 3 and 4 show different ways in which the shackle balls may be introduced with advantage.

THE ELECTRIC LIGHTING OF PARIS

THE Paris Municipal Council has lately been holding some important discussions as to the electric lighting of Paris. We may at once say it is only now a question of private lighting. The electrical companies which have entered into negotiations with the City of Paris only hold the right, in certain streets, of making electrical canalisations with a view to furnishing the householders with the electric lamps they may want. As to public lighting—that is to say, of the streets and municipal buildings—that will become the object of conventions of the city with the companies, for, as is well known, the municipality is at once about to instal, in the cellars of the Halles, a municipal electrical department.

The electric light companies at present recoil before the requirements of the Municipal Council. One of the articles on which the discussion ran highest was regarding the obligation to light a certain number of streets within a period fixed by the act of concession. The Municipal Council, after having put forward as a principle that the districts conceded to the companies should have the form of segments of a circle, proceeding from the centre of Paris to the fortifications, so that the peripheric quarters, like those of the centre, should be provided with electrical installations, stipulated that within a period of four years those holding the concessions should have lighted the whole of their segment.

This was imposing very onerous conditions on the companies. In the peripheric quarters, where, generally, the population is sparse, the concessionaires would be put to an unproductive expense which the profits realised in their central installation would for a long time fail to cover.

A committee of the Municipal Council took all this into consideration, and drew up for the six companies which applied for authority to establish electric conductors on the right bank of the Seine, districts comprising a certain number of streets which the concessionaires undertook to light within a period, not of four years, but of two years only. The streets naturally were situated in the centre *quartiers*. The periphery was menaced with being totally deprived of electricity. It was then that several members of the Municipal Council, adopting in principle the transaction which was proposed to them, required, on the other hand, that the concessionaires should engage to light within a period of two years altogether the streets named in the act of concession, and the streets which delimitate the *sector* conceded to them, and which, as already stated, extends to the fortifications. In this way the peripheric *quartiers* would not be completely deprived of electricity, and electric installations would consequently exist from the centre to the extremities of Paris.

Four companies have accepted this proposition—namely, the Gaston Censier Company, the Electric Light Company of the Place Clichy Sector, the Parisian Electricity Company Victor Popp, and the Parisian Electric Company of M. Surry-Montaut. On the other hand, the Edison and Marcel Deprez Companies refused, and held to the lighting limited to the centre *quartiers*.

The spokesman of the Committee, M. Lyon-Alemand, proposed to the Council to coincide with the views of the two latter companies. The Council, however, was opposed to this, and decided that the concessions should only be granted to the companies which approved all the clauses contained in the stipulations.

The whole business will probably end by an arrangement being come to with the Edison and Marcel Deprez Companies. In any case the following are the streets which delimitate the sectors of the six companies :—

Gaston Censier District.—Avenue de la Grande Annêe, Avenue des Champs Elysées, Rues de Rivoli, du Louvre, Montmartre, du Faubourg Montmartre, de Chateaudun, de Londres, de Constantinople, de Rome, Cardinet, and de Tocqueville.

The sector of the Place Clichy Company's district.—Boulevard Pereire, Rue de Rome, Boulevard Haussmann, the Rues de Havre and d'Amsterdam, and the Avenues de Clichy and St. Ouen up to the fortifications.

The Victor Popp Company's district.—Rue de Belleville, Faubourg du Temple, Place de la Republique, the great boulevards, Rues Royale and de Rivoli, Place de la Concorde, and the quays on the right bank up to the fortifications.

The Surry-Montaut Company's district.—Boulevards Ornano and Barbès, Faubourg Poissonnière, Rues Poissonnière, des Petits Carreaux, Montorgueil, Baltard, and du Pont Neuf, Quais des Orfèvres and du Pont Neuf, Rue de la Cité, parvis Notre Dame, Point d'Arcole, Rue du Temple, Rues de l'Entrepôt, de Lancy, des Récollets, Faubourg St. Martin, and Rue de Flandre.

The Edison Company's district.—Avenues de Saint Ouen and de Clichy, Rues de Clichy and de la Chausée d'Antin, the great boulevards up to the Rue Richelieu, the Place de la Bourse, the Rues Joquelet, Montmartre, the great boulevards up to the Rue du Faubourg, Saint-Denis, the beginning of Rue du Faubourg Saint Denis, Faubourg Poissonnière up to the Rue d'Englien, the Rue Bergère, the Rue du Faubourg Montmartre, Rue Grange Batelière, Rue Geoffrey Marie, Rue Richer, Cité Trévise, Rue Bleue, Rue Lafayette, Place Cadet, Rue Rochechouart, Boulevard Rochechouart, the Rues Clignancourt, Ordener and du Mont Cenis.

As to the district conceded to the Marcel Deprez Company the following is the delimitation thereof :—The boulevards Ornano and Barbès, the Boulevard de Magenta, the Place de Roubaix, the Rue de Dunkerque, the Boulevard Denani, the Rue du Faubourg Saint Denis, the Rue d'Aboukir, the Rue du Caire, the Boulevard de Sébastopol, the Boulevard Saint Martin, the Place de la République, the Rue de la Douane, the Quai de Valmy, and the Rue d'Allemagne.

All these companies have to lodge a deposit of 300,000 francs with the municipal authorities, except the Clichy Sector Company, whose district is smaller, and which only has to deposit 100,000 francs. It may be remarked that these sectors superpose in certain places and the companies can therefore compete in the *quartiers* where their districts are superposed. Under these circumstances electricity will not be long delayed. In the other streets, besides those which have been specified in the conventions entered into with the municipality, the enumeration of which would occupy too much space, the companies will be able to establish canalisations when the subscriptions received shall have attained 750 watts per 10 mètres and per year.

A few days since a company made propositions to the prefectoral administration with regard to the left bank of the Seine, and when the application has been studied by the Works Department of Paris, the Municipal Council will be called upon to examine it. It is to be hoped now, in the sectors in which the concession has been definitely approved by the Council, that the works will be pushed forward with the greatest activity, in order that the municipality, on its part, may be able to light a certain number of its arteries under conditions as satisfactory as those of other great cities of the two worlds and even some small communes of Paris. Paris in this respect is in a sad state of inferiority for the position it occupies among great cities.

ELECTRIC RAILWAYS IN THE UNITED STATES.

OUR contemporary, the New York *Electrical Engineer*, in its issue for December, 1888, gives a table, with particulars of gauge and length of lines, weight of rails, H.P., &c., of the electric railways at present in work, in construction, and under contract.

From this table we gather that the length of lines in actual operation is about 247 miles, distributed among 52 roads.

We find that the electric systems employed are as follows :—Thomson-Houston, 22 ; Sprague, 12 ; Daft, 9 ; Van De Poele, 3 ; Fischer, 2 ; Bentley-Knight, 1 ; Short, 1 ; Henry, 1 ; Unnamed, 1.

The largest mileage at any one locality is at Richmond, where 13 miles of line are worked on the Sprague system ; there are also 12 miles at Hartford worked on the Sprague system.

The lines in construction, or under contract, number 47, with a total length of about 346 miles. At Minneapolis, 69·5 miles are to be worked on the Sprague system ; at Cleveland, 23·5 miles, also on the Sprague system, and at New York, 18·5 miles, with storage batteries. These form the principal installations.

The electric systems adopted are as follows :—Thomson-Houston, 13 ; Sprague, 13 ; unnamed, 9 ; storage batteries, 5 ; Daft, 4 ; Fischer, 2 ; Bentley-Knight, 1.

It will be noticed that although the Thomson-Houston system has been adopted on more roads at present working than the Sprague, yet the latter has been, and is to be, employed on nearly all the more important, so far as mileage goes, roads. Storage batteries do not appear to have been made use of in any of the lines actually working. It would appear, however, that they are now being viewed with a little more favour, since in the table of roads in construction or under contract, five of the lines are to be worked by storage batteries.

REVIEWS.

Bell Hangers' Hand-Book. With 97 illustrations. By F. B. BADT, late First Lieutenant Royal Prussian Artillery. Electrician Publishing Company, Chicago, America.

THIS small book is of a very similar nature to that of Mr. Bottone, which we recently noticed, but it is, perhaps, rather more voluminous. As in the work referred to, there are rather unnecessary descriptions of forms of batteries which are entirely unsuited for electric bell work, or, indeed, work of an allied nature. Besides electric bells, electric gas lighting apparatus is dealt with. Altogether, the book is a very useful production, and is one which we can recommend.

Journal of the Society of Telegraph Engineers and Electricians. No. 75, Vol. XXII. London : E. and F. N. Spon, 125, Strand.

THE contents of this number are as follows :—"On Ocean Temperatures in Relation to Submarine Cables," by W. Lant Carpenter, B.A., B.Sc., member ; "The Physical and Electrical Effect of Pressure and Temperature on a Submarine Cable Core" (original communication), by Charles Bright, member ; "On a System of Electrical Distribution," by Henry Edmunds, member. Abstracts :—"Hertz's Researches on Electrical Oscillation" (*resumé* of), by G. W. de Tunzelmann ; reprinted from the *Electrician*.

Ore Stamping by Electricity.—Considerable attention has been lately attracted in the Nevada mining districts to the practicability of working ore crushing mills with electromotors, the dynamos being driven by water power. It is considered that this is the only system sufficiently economical in its working to permit of low class ores being treated at a profit.

NOTES.

Novel use for the Electric Light.—It is reported that in the Place du Carrousel, Paris, a large crowd collects nightly round the electric lights. Taking hold of each other's hands a chain is formed, and the person nearest the candelabra taps the current—how, is not explained—thus giving an electric shock to the whole ring. This diversion has been going on for nearly a fortnight, and the number of experimentalists is stated to be nightly increasing.

The Electric Light in Paris.—The commissions appointed for examining the tenders for the lighting by the municipality of the Halles Centrales have accepted the proposals of the Belleisle Company for the boilers, and for the engines those of Messrs. Weyher and Richemond, who supply three triple expansion engines of 140 H.P., and of Messrs. Leconteux and Garnier, who supply three single cylinder engines of 170 H.P. The French Edison Company has the contract for six dynamos, each having an output of 400 ampères at 110 volts, and Ferranti supplies three Ferranti dynamos, each of 113 kilowatts capacity

Electric Light at Metz.—Among the Continental towns which first adopted electric lighting on anything like a large scale, Metz claims a prominent position, and it deserves honourable mention, not alone on this account, but also for the variety of purposes to which the electric light is there applied. There are no less than five separate and distinct systems in operation, namely : The town lighting ; the lighting of the railway stations and railway approaches ; the Government installations for lighting the ramparts, and the search lights for illuminating the surrounding country ; the lighting of the barracks and the portable plant for accompanying troops while skirmishing at night.

The Electric Light in Private Residences.—Braehead, near Dumbarton, the residence of Mr. A. Denny, is lighted entirely by electricity. In the engine room is a two horse-power Otto gas engine driving a shunt-wound dynamo, working at one thousand revolutions, supplied by Messrs. Paterson and Cooper. The engine room is divided by a wood and glass partition into engine room proper, and accumulator room. In the accumulator room are 26 E.P.S., 1888, 15 L-type cells. The engine room is situated in a cellar underneath the drawing room, and it is a model of cleanliness and neatness, well lighted and ventilated. There are in all 54 lights ; two 50 candle-power, eighteen 20, and the remainder 10. The work of erecting and running the leads, &c., was entirely carried out by the electrical staff of the Leven Shipyard.

Derby and the Electric Light.—At the last meeting of the Derby Town Council, the Mayor said he had recently received communications from electricians who were anxious to submit some scheme to the Corporation for lighting the town with electricity. It was an important matter, and he would therefore move that it be referred to the Parliamentary Committee, with the addition of the chairman of the Free Library and Highways Committee. Alderman Russell did not think electric science was sufficiently advanced to warrant this action, and Mr. Foster urged that no expenditure should be incurred, while other members concurred with the motion. Ultimately it was agreed to, the chairman of several other committees being added to the committee named.

Electric Christmas Tree. — At the West London Hospital on the 2nd, a large tree was lighted by the Woodhouse and Rawson Electric Manufacturing Company, who are close neighbours of and take a great interest in the hospital, the result being much appreciated by the large company who assembled to assist the secretary and officials in amusing the patients.

Valencia Installation.—The central electric lighting station at Valencia is up to the present the largest in Spain. The engines are of Westinghouse type, but the dynamos were made in Spain by Planas, Flaquer y Cia, of Gerona, and are of the continuous current compound type.

The City and the Electric Light.—At the last meeting of the Commission of Sewers Mr. Thompson asked why tenders for the electric lighting of the City had not yet been advertised for. He believed the matter was left for the engineer to draw up specifications and insert advertisements. The Chairman said the matter had been referred to the Streets Committee by the Commission. The Streets Committee referred it to the engineer, solicitor, and an expert, Mr. Preece. They had met the committee on several occasions. He understood that so far as the engineer was concerned his portion of the work was completed. It now remained with the expert and the solicitor. He thought they would be ready to report at the next meeting of the committee, and after that there would be a report to the Court. No tenders could be invited until these arrangements were absolutely completed. Mr. Innes said he had noticed in the public papers a statement that the Government did not intend to grant any licences, but to include various applications in a Provisional Order, which would have to take the shape of a Bill and be referred to Parliament. He asked whether it was right for the Commission to obtain a *locus standi*. The solicitor (Mr. Baylis) said he apprehended that would be the proper course with regard to a Provisional Order. The Commission would have to be represented as usual. A resolution passed at the Aldgate wardmote in favour of electric lighting was referred to the Streets Committee.

Electric Lighting in Ireland.—In the far West of Ireland electric lighting is pushing its way. For some time the Galway Electric Company has illuminated a part of the old town with arc lights, and is now busy with incandescent lighting for private work, and enquiries for motive power are numerous. The company is a private local concern, represented professionally by Mr. James Perry, M.E., the county surveyor of Galway, and Mr. Arthur W. Slater, A.I.E.E. Some extensive mills, with ample water-power have been acquired, and arrangements have been made for more power, should it at any time be required. The company's proposals for lighting the town are being considered, and it looks hopeful when the Commissioners have informed the gas company that their arrangement with them may end with the financial year. The company's operations have had the effect of reducing the price of gas from 6s. 6d. to 4s. 9d. per 1,000 cubic feet.

Lighting a Brewery.—Messrs. Garton & Co., of Shepton Mallet, have recently lit up their extensive brewery with the Thomson-Houston system of electric lighting. The installation consists of 18 lamps, of 1,200 candle-power each. The work has been carried out by the engineers to the Taunton Electric Lighting Company, Messrs. Laing, Wharton & Down, London, the chief engineer and expert being Mr. A. D. Brown. It is understood that Messrs. Garton & Co. contemplate still further extensions of the light, as they are so thoroughly satisfied with the result.

Paddington and the Electric Light.—The Paddington Vestry has "accepted with pleasure" an invitation from the Electrical Power Storage Company to visit its works at Millwall, in order that it might be seen that the central depot which the company wishes to establish in Paddington would be employed in lighting the district only and upon a system of its own, in every way complete in itself. The chairman seemed to have some misgivings with regard to this move, for he remarked that it was hardly the time to accept such an invitation, as it would appear to be giving one company a special advantage.

Protest against Electric Lighting Works.—A meeting of the residents of Pall Mall and St. James's Square was held at Willis's Rooms last week to protest against an alleged nuisance caused by the Pall Mall and St. James's Electric Lighting Company's engine and other works in Mason's Yard, Duke Street, St. James's.—Mr. Keevil, who occupied the chair, prefaced his remarks by stating that he was not in any way connected with any electric lighting company, and that the sole reason why he had taken the initiative in the matter was because he was one of the minority in the St. James's vestry who from the outset opposed the application of the St. James's Electric Lighting Company to erect a central station in Duke Street. He stated that he had received several letters from the residents in the immediate neighbourhood of the works strongly protesting against the works, and concluded by moving the following resolution :—"That this meeting is of opinion that the installation and erection of a central station for electric lighting for the parish in the immediate neighbourhood of Pall Mall and St. James's Square is calculated to injure the commercial and residential value of property in the neighbourhood, and is quite unnecessary in view of facilities for bringing the current from distant localities more suited for the purpose." The motion having been seconded by Mr. Davies, Mr. Foster, who stated that he was interested in the St. James's Electric Lighting Company, opposed the motion, contending that the works would be a boon to the neighbourhood. Mr. J. T. Musgrave also thought that the electric works would not create any nuisance, as smokeless coal was to be consumed and the company would consume their own smoke. The resolution was supported by Mr. J. Bray (Kensington vestry) and one or two residents, and upon being put to the meeting it was carried by 19 to 11.

Electric Lighting in Birmingham.—The sub-committee of the General Purposes Committee of the Birmingham Corporation, which has the matter of electric lighting in hand, met last week and settled the recommendations on which its report to the General Purposes Committee will be founded. It is understood that several important amendments of the draft Provisional Order submitted by Messrs. Chamberlain and Hookham were agreed upon, affecting, amongst other things, the amount of capital required for the undertaking, and the formation of a company. These and other points, it is understood, will be discussed with the promoters before the report is formally prepared, and possibly an agreement may be arrived at. The report will then be discussed by the General Purposes Committee, and will be presented to the Council early in February, as the consent of the Council must be given in that month or the Provisional Order cannot be obtained next session, and the town will then have to wait for at least another year before any serious attempt is made to provide a system of electric lighting.

Electric Lighting in Leeds.—There is abundant evidence that the advantages of the electric light are not being overlooked by large firms in Leeds. Messrs. E. Miller & Co., house furnishers, North Street, have recently had a large addition made to their already extensive premises. The new premises are lighted entirely by electricity, and almost the whole of the old portion has also been fitted up with the electric light. The plant used comprises one of Crompton's new patent wrought-iron dynamos, capable of lighting 200 16-candle-power lamps. This is driven by a 16 horse-power Crossley gas engine. To ensure perfect steadiness, a high-speed flywheel is used. In the ground floor show-rooms the lamps are arranged in groups of five and three, and are hung from pendants. They are of the Edison-Swan types, of 16 C.P. In the other show-rooms the lamps are grouped in fours. The windows on the ground floor are lighted by 25 candle-power lamps. The installation has proved entirely satisfactory. The work has been carried out by Mr. Wilson Hartnell, of Leeds.

Newcastle and the Electric Light.—At a meeting of the Sanitary Committee of the Newcastle Corporation last week, a letter was read from Messrs. Leadbitter and Harvey, solicitors, giving notice of an application they intend to make on behalf of an electric company for leave to introduce an installation in one of the districts of the city. The district has not been named, but will probably be Jesmond, where the gas supply is supposed to be deficient.

An Electric Lighting Mishap.—On Thursday evening the carbon of one of the arc lamps used for lighting the Parade, at Warwick, fell from the lamp, fired the leads, and set fire to the pole on which the lamp was suspended. The fire was promptly extinguished by the police and the employés of the Electric Light Company.

Lighting Petroleum Steamers.—The curious, massive tank-steamers, specially fitted for the Batoum petroleum trade, are fitted throughout with the electric light.

Electric Lighting of the North Sea Canal.—*Industries* states that Mr. Philip Michaelis, London, has sent a petition to the Dutch Government, asking for an exclusive concession to light electrically the North Sea Canal from Amsterdam to the North Sea. This request has been refused, the Government stating that exclusive concessions are against the public interest; moreover, the absolute necessity of lighting up this large waterway at night is not yet apparent.

The Telephone and Fires.—The National Telephone Company has received an excellent testimonial to the utility of its telephonic service in Birmingham from Mr. J. Beaumont Jones, clerk to the Finance and Fire Brigade Sub-Committee of the Birmingham Town Council. Mr. Jones says:—"By its means not only are subscribers able to convey information of the outbreak of fire on their own premises, but on several occasions fires occurring in the neighbourhood of a telephone subscriber's office have been reported to the central station, and the delay which must otherwise have occurred, and which is so disastrous, has been avoided."

The Telephone Exchange at Devonport.—The Western Counties and South Wales Telephone Company has decided to keep open its exchange at Devonport between the hours of 8 a.m. and 8 p.m., and as soon as the present number of subscribers is increased to 40 to concede an all night service. At Plymouth, where the exchange is in connection with that at Devonport, there are over 200 subscribers and the exchange is open all night. It is interesting to record the fact that not one person in a hundred of those who join the exchanges in the three towns ceases to subscribe except on death, removal, or bankruptcy.

Telegraph Facilities at Barnstaple.—The Barnstaple Town Council has been endeavouring to induce the Postmaster General to afford the borough greater facilities for telegraphic communication. A reply has been received stating that inquires are being made with the view of ascertaining how far the circumstances would warrant the keeping open of the Barnstaple office to a later hour.

The Postal Telegraphs.—The revenue returns for the twelve months ending on December 31st, show a hopeful, if not very substantial improvement in respect to the postal telegraphs, especially in view of the steady growth and development of telephones. In the first two quarters of last year the amount received was in each case £480,000, compared with £445,000 and £465,000 respectively in the same periods in 1887. In the third quarter the amount rose to £565,000, as against £540,000, and in the last quarter the sum was £515,000 as against £465,000 in the last quarter of 1887. The total for the whole year was thus £2,040,000, contrasted with £1,915,000 in 1887, or a gain of £125,000.

Recent Interruptions and Repairs to Submarine Cables.—

Cable between.	When interrupted.	When repaired.
Suez-Suakin ...	21st Nov., 1888	27th November, 1888.
Milazzo-Zipari ...	29th „ „	11th December, „
Suakin-Perim ...	21st „ „	11th „ „
Trinidad-Demerara	13th Dec. „	Still interrupted.
Chorillos-Mollendo...	11th „ „	20th December, „
Jamaica-Colon ...	23rd „ „	Still interrupted.

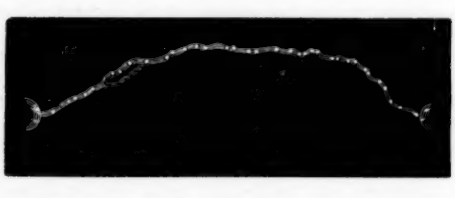
Interruptions in Australian Cables.—In consequence of the frequent interruptions which have recently occurred on both the cables which unite Australia with England, *viâ* Java, it is the intention, as we have already stated, of the Eastern Extension, &c., Company, to lay a third cable between the vicinity of Banjoewangi and a point in Western Australia. This attempt to get over the difficulty will probably be more advantageous to the contractors than to the Australians, as the "volcanic region," close to Banjoewangi, will have to be passed through, and the water between there and Beagle Bay (or Roebuck Bay) has a depth of 3,000 fathoms, while for more than 100 miles from the Australian coast the cable will have to lie on a coraliferous shoal of less than 100 fathoms in depth. This cable may fairly be said to be one which, starting from a volcanic region, passes through unkown depths and terminates on a coral bed. The fact that the cable will join the Western Australian landlines instead of the main landlines across the Australian Continent, a change of route evidently intended as an amelioration, does not do much to improve matters, as it is the cables which are complained of, not the landlines.

Electrically Refined Sugar.—Prof. Silvanus Thompson thus writes to the editor of the *Times*:—Sir,—In October last you did me the favour of inserting a letter in which I sounded a warning note to the too-confiding investor, pointing out that so far not one shred of proof had been forthcoming that electricity had anything whatever to do with the so-called process for the "electric" refining of sugar. Nor was I alone in my disclaimer, for in all the technical electrical journals similar warnings as to the true nature of this alleged process were given in guarded, but unmistakeable terms. Unfortunately, it would seem that would-be investors prefer the opinions of every other sort of adviser to that of those persons who have made the study of electricity and its powers their life-long pursuit. The result is that, whereas a week ago they were clamouring for the privilege of buying up the shares at 300 per cent. premium they now learn, on unmistakeable authority from your Philadelphia correspondent, that the whole thing was a shameless swindle. They now know that the name "electric" was a mere cover for a vulgar cheat, in which previously refined and crystallised sugar was surreptitiously conveyed into the "factory" and substituted, behind locked doors, for the unrefined article. This is not the first swindle in which the word "electric" has been skilfully used by the knave to dupe the fool; nor, I fear, will it be the last.

The Académie des Sciences.—The *Comptes Rendus* for December 24th is devoted to the address of the president, M. Janssen, and to a list of the prizes for the year 1888, granted for the subjects as follows:—Geometry, four prizes; mechanics, four prizes (including a special prize of 6,000 francs); astronomy, four prizes; physics ("subject: the perfecting of some important point in connection with the theory of the application of electricity to the transmission of work"), one prize; statistics, one prize; chemistry, one prize; geology, one prize; botany, two prizes; agriculture, one prize; anatomy and zoology, three prizes; medicine and surgery, five prizes; physiology, one prize; physical geography, one prize; general prizes, six in number. A list of proposed prizes for the years 1889, 1890, 1891, and 1893, is also shown. Full details are given with reference to the donors of the prizes, their value, conditions under which they are granted, &c.

Cornell University.—The "Cornell University Register" for 1888–9, which has been sent to us, contains much interesting information relating to the history, organisation, and present position of the institution. Attention is called to recent important additions to the corps of instruction, including the election of a professor of electrical engineering. Under the head of material equipment of the University a description is given of the buildings, museums, laboratories, library and grounds. The museums and collections of the Sibley College of mechanical engineering and mechanical arts are of exceptional extent, value and interest. Extensive special collections of apparatus have been obtained for the work in electrical engineering. In addition to the extensive collections of the department of physics for ordinary laboratory instruction, that department possesses a large number and considerable variety of larger apparatus, including the great tangent galvanometer, and the outfit of the magnetic observatory, and several Gramme and other dynamos. In the Sibley College, also, are a number of dynamos, including an Edison, a Mather, a Westinghouse alternating machine, and Weston dynamos, ranging from the smallest sizes up to a 650-light alternating-current machine, all placed in a room adjacent to the machine-shop, where the very considerable power demanded can be most conveniently furnished. A Brackett "cradle" dynamometer and a resistance coil measuring up to 2,200 ohms and 4 ampères, and the tangent galvanometer measuring from a fraction of an ampère to 250 ampères supply the means of making quantitative measurements of heavy currents.

The Duration of Lighting Flashes.—It is well known that the lighting flash, or the spark between the terminals of an influence machine, says *Engineering*, exists for so short an interval of time as to be beyond measurement by any ordinary means. But notwithstanding the acceptance of this knowledge, the peculiarities of some of the flashes photographed have been supposed to be due to the camera, or the sensitive plate, being at the time in a state of vibration. To test this line of thought, Mr. James Wimshurst has made a dark slide for his camera, in which is fitted a train of clockwork carrying a disc, upon which is an arrangement for holding the sensitive plate. When all is complete for photographing a flash, the clockwork is wound up, the sensitive plate then rapidly acquires great velocity, which at the maximum reaches 2,500 revolutions per minute, and with the plate rotating at this speed, the



spark is photographed. The annexed engraving is from a photograph taken under these circumstances; as will be seen, it in no way indicates movement in the sensitive plate, for the photograph throughout its length is as sharp and as clear as though the plate had been at rest. The experiment is interesting, for it not only shows the infinitely short existence of the spark, but it also shows that chemical change in the sensitive film takes place in an equally minute interval of time.

Armstrong's Improved Fastenings for Bolts and Nuts.—The Walsall Electrical Company is making these improved fastenings, which are designed to save the inconvenience and expense of frequent inspection and screwing up. The fastening consists of a cap which renders the nut immovable by any disturbing influence except destruction. It also affords protection from rust or corrosion.

Dynamo Troubles.—"E.R.T." asks in the *Electrical World* if any reader can inform him as to the cause of the brushes on a No. 1 alternating current dynamo arcing at times with a sharp report. He has taken great care with them and had them very smooth and clean. They will run for two or three hours and then arc, then run all right for a few days and then arc again, and so on. At times the current does not come on as it should, it appears to stick, and when he touches the exciter brush it comes on at once. He takes great care of the brushes and examines them every day.

Electric Railway in Burgenstock, Switzerland.—The track of this road is only 936 metres long, but the difference of level between the two extremities is 440 metres, giving thus a mean gradient of 53 per cent. The gradient is not quite uniform, and the upper part gives a rise of 57·7 per cent. Water power is used and the transmission is effected electrically. The electrical plant has been furnished by Messrs. Cuénod, Sautter & Co., of Geneva. Two cars are used, which counterbalance each other, that is to say, one ascends whilst the other descends. The electric power, therefore, serves merely to overcome the friction of the apparatus and to counteract the differences of loads in the cars, and the power is said to be very variable. The current is generated by two dynamos, with a capacity of 30 H.P. The circuit extends over a distance of 4 kilometres, leading to two equal motors.

Endolithic Ivory.—We have lately noticed some remarkably satisfactory work in the way of ivory tablets for switchboards and switches, and find on enquiry that they are prepared by a process which has been worked with very great success since its introduction about a year ago, as many as 300,000 pieces for various purposes having been supplied in that short period. As it becomes better known new demands spring up and there is no doubt that ivory treated in this way will entirely supersede that lettered by any other means. The advantages of the process are that the lettering is not merely on the surface, but becomes part of the ivory so that it cannot be rubbed off by any amount of friction, and the inscription is beautifully distinct, remaining so till the ivory itself is destroyed. Some pretty badges of this endolithic ivory were worn by the officials at the late military tournament, and it is used for organ stops and permanent labels of every description. Though we believe it is known by most of the leading electrical firms there may be some who will thank us for calling their attention to it.

Sell's Dictionary of the World's Press.—This book, now in the ninth year of its annual issue, has so grown that it contains 1,400 large pages, and has the outer edges of its pages coloured and lettered to show readily the sections into which it is divided. It contains articles of special interest and value about the libel laws, about new and improved printing machinery, suggestions in the way of designs and engravings for advertisements, and a series of illustrations showing the architectural character of the great newspaper offices in London. The history of the principal daily papers is given in brief, and there is pleasant information about journalism in Japan and elsewhere. One notable feature of the book is the 64 pages of portraits of "Heads of the Press" printed on special plate paper. These contain admirable portraits of the editors or proprietors of the chief papers in London and the provinces.

Electricity in the Royal Navy.—A favourable opinion is entertained among naval officers of the newly-invented engine room electrical telegraph which was recently erected for examination near the electric shop in Portsmouth Dockyard. Simplicity and accuracy are considered to be the predominant characteristics of the new telegraph, and it is anticipated that its introduction into the service is only a question of time.

Electric Motors in America.—The development of the application of electric motors to the working of machinery in industrial establishments appears to have made great strides during the past year in America. The total number of motors employed in driving machinery is calculated at about 6,000, of which number it is estimated that 4,000 have been put in operation during 1888.

Storage Batteries in the States.—The Julien Electric Company seem to be doing a good business. From November 1st to 16th, 11 installations were fitted up with the Julien storage battery, representing 1,540 accumulators. The New York and Harlem electric railway, with 18½ miles of road, is to be worked by Julien batteries.

N. D. Telephone Directory.—The little pocket directory issued quarterly by the Northern District Telephone Company at Sunderland, has a circulation of 10,000 copies, each containing an insurance coupon for £100. The new edition directs attention to the extended use of telephones in mines, where they are not only of value as a means of communication, but also as a means of safeguard and protection against accidents.

Electric Meters.—A Continental correspondent asks us: Which is the best meter, that of Ferranti or Aron? We do not care to express an opinion on the matter; but doubtless some of our readers, with practical experience of both instruments, will willingly give the information requested.

London Central Subway Electric Railway.—A meeting of ratepayers of Holborn was held at the Prudential Assurance Company's offices, Holborn Bars, last week, to oppose the projected London Central Subway Electric Railway. Mr. Gainsford Bruce, M.P., presided, and pointed out what he considered to be objections to the project. There were several speakers, who thought the railway was calculated, if carried out, to seriously prejudice the interests of the tradespeople along the line of route, and resolutions opposing the company's Bill upon that ground were passed. It was stated that the Holborn District Board of Works had decided to oppose the scheme.

New Wall Fitting.—Messrs. H. and E. J. Dale, Limited, have designed a new wall fitting for flexible leads used in connection with electric lighting. The apparatus is neat and simple, and we can recommend contractors to inspect it.

A Grievance.—"D. N.," writing to the *Times* on the 3rd inst., makes the following complaint, which apparently places a certain electric lighting company in a very invidious position, and we certainly think that some explanation should be forthcoming, either from the company or from the contractors who wired the house:—"Being desirous of lighting my house by electricity and not understanding the subject, I entrusted a first-rate firm of West End engineers with the task of wiring the various rooms, and making the necessary arrangements with the company supplying the district for connecting their currents. The company thereupon sent their own workmen and prepared for the reception of the requisite apparatus for measuring the current, and I went to very considerable expense for wiring and fittings. The company then declined to supply the current unless I signed an agreement giving them permission to place a pole on the roof of my house, stating that this is their rule. Knowing, by the experience of others, that this means an intolerable nuisance, besides damage to the roof and to the interior in wet weather, I declined to submit to this condition, and I think that anyone having the intention of adopting electric lighting would do well to carefully consider what it may involve under existing circumstances."

Electric Traction in Birmingham.—On Wednesday afternoon last week, one of the new cars which have been constructed for the Birmingham Central Tramway Company, left the depôt at Kyott's Lake Road, for a further experiment with the electric motor. The car was weighted to an extent greater than the average weight of an ordinary full car, and, after travelling along the Sparkbrook route, was taken over several of the other routes connected with the system. The several inclines and declines were worked very successfully, and the engineers expressed themselves satisfied with the experiment on retiring to the depôt.

Festivities.—The annual supper of Messrs. Laing, Wharton and Down's staff took place at the Queen's Arms Hotel, Queen Street, E.C., on Saturday, the 29th ult., when a large number sat down to an excellent repast. A long programme of songs, interspersed with toasts, was afterwards gone through. The Health of the Firm was drunk with acclamation, not a little increased by the fact that the engineer, Mr. D. C. Bate, who took the chair, was able to announce even better prospects for the coming year, busy as 1888 had been, several important contracts for Thomson-Houston arc as well as incandescent plants having been secured.

Reckenzaun Cars in America.—Messrs. Edwin K. Alsip & Co., of the Sacramento Tramways, have written as follows to the secretary of the Pacific Electrical Storage Company, San Francisco:—"Yours received. The car is giving very good satisfaction. We are running 36 miles a day on a charge for each battery. We think it is a success, and shall order more cars as soon as satisfactory arrangements can be made, for which negotiations are now pending. From our experience we should not hesitate recommending any one for a railroad to use the storage battery cars, as we are satisfied they will be the coming power, and in cities without heavy grades will be universally adopted." Such a testimonial as this coming from practical tramway men needs no comment, but it binds us still more closely to our oft-expressed opinion that electric traction by means of accumulators will eventually be used all the world over.

Old as the Hills.—The idea of applying electricity to the refining of sugar is by no means new, for we find that the earliest mention of any electrical process was in 1848, when a patent was granted to a Mr. Clement for the "clarification, &c., of sugar by electricity."

School Lighting.—The *Schoolmaster* thinks that there seems to be no reason why electric lighting should not be introduced to the school-room. It has already found its way into the Holy Trinity Schools, Eastbourne, as described by Mr. Thomas Ryder. "Take our schools," adds Mr. Ryder, "as an example. We have over 600 children in attendance. At this time of the year towards 3.30 we must light up for an hour; the air is already vitiated, and brains begin to be fagged as a consequence. All at once 70 gas jets, at least, are alight, and each, at a low computation, consumes as much oxygen as six persons; the equivalent of 420 more people is crowded in, whose breath—well, we will not say what they breathe out, the chemists will tell us that. With the new light all this is changed, and the last hour goes, not so easily as the first—that is impossible—but I hardly know how fitly to describe it."

Personal.—We regret to hear of the indisposition of the City Engineer, Lieut.-Colonel Haywood, to whose report on the proposed electric lighting in the City we referred last week. Colonel Haywood has gone to the South of France for the benefit of his health.

Mr. F. Bathurst has been appointed the London agent for the *Electro-Mechanic*, an American journal, the first number of which we noticed in our columns for August 31st last. Mr. Bathurst was lately with Messrs. Woodhouse and Rawson, but is now working on his own account, and is open to accept business agencies.

Broughty Ferry in Darkness.—Broughty Ferry had a bad quarter of an hour on the night of New Year's Day. Owing to a mishap at the gasworks, the gas supply was suddenly cut off about seven o'clock, and as a consequence all the lights, except those on the higher level, went out.

Electric Launches in Scotland.—Mr. James Adam, shipbuilder, of Gourock, has contracted for a new electric launch, to be built from the designs of Mr. G. L. Watson.

The Edison Chemical Meter.—We have to acknowledge the courtesy of Mr. W. J. Jenks in sending us from New York advanced proofs of his paper on the Edison chemical meter, a portion of which is reproduced in our other columns.

Equitable Telephone Association.—After all its fine professions and boasting the Equitable Telephone Association has ignominiously succumbed. For nearly two years past it has been inducing people to purchase its telephones by guaranteeing them against claims for infringement. Now we are favoured with the announcement that, the shareholders of the Association in general meeting having decided not to provide further funds to continue the litigation, the Association is unable to further contest the question of infringement raised by the United Telephone Company, and finds no course open but to submit to a perpetual injunction. The United Telephone Company has undertaken not to make any claim for damages against persons who have purchased or have been supplied with telephone instruments by the Association for their own use, provided they delivered up such instruments intact by January 4th. Purchasers under the guarantee will, doubtless, be glad to learn that the Equitable Telephone Association in these circumstances regrets that it can only suggest that customers shall give up their instruments to the United Company accordingly, and by so doing avoid possible liability. The Association, having no further funds, and the injunction practically putting an end to its business, will now be obliged to wind up its affair.

NEW COMPANY REGISTERED.

Newcastle-upon-Tyne Electric Supply Company, Limited.—Capital £50,000 in £5 shares. Objects:—To supply electricity for lighting and other purposes within the city of Newcastle and elsewhere within the counties of Northumberland and Durham, and generally to carry on business as electricians, mechanical engineers, and as workers and dealers in electricity. Signatories (with one share each):—T. W. Gibson, F. R. Goddard, A. W. Heaviside, electrical engineer, M. L. Lambert, Riley Lord, T. Merz, J. Price, R. S. Watson—all of Newcastle-on-Tyne. The signatories are to appoint the first directors; qualification, £100 in shares or stock; the company in general meeting will determine remuneration. Registered 8th inst. by Pattison, Wigg & Co., 11, Queen Victoria Street, as agents for Watson & Dendy, Newcastle-on-Tyne.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Telephone Company, Limited.—The annual return of this company, made up to the 3rd inst., was filed on the 4th inst. The nominal capital is £120,000, in £5 shares. 3,000 shares have been taken up, 1,000 of which are considered as fully paid. Upon the remaining 2,000 shares £4 10s. per share has been called, the calls paid amounting to £8,688 and unpaid to £312.

Telegraph Improvement Company, Limited.—The annual return of this company, made up to the 1st ult., was filed on the 1st inst. The nominal capital is £100,000, in £1 shares. 15,006 shares have been taken up, 15,000 of which are considered as fully paid. Upon the remaining six shares £1 per share has been called and paid.

Electro-Galvanic Machine Company, Limited.—An agreement of 3rd inst. provides for the purchase from Norman Willis Russ, of 21, De Crespigny Park, Denmark Hill, electrician, his rights in connection with the letters patent dated October 1st, 188 , No. 13,326, granted for improvements in machinery or apparatus for producing and administering electric shocks and currents. The purchase consideration is £200 cash, £800 in cash or fully paid shares, at option of the vendor, and 1,000 fully paid shares, which will not be entitled to dividend for the first year until 25 per cent. has been paid upon the other shares. The registered office is at 83, London Wall, T. H. Wakefield, secretary.

Bernstein Electric Lamp Company, Limited.—The annual return of this company, made up to the 31st ult., was filed on the 4th inst. The nominal capital is £100,000, in £10 shares. 2,814 shares have been taken up, and the full amount has been called and paid thereon. The registered office of the company is removed to 2, Marlborough Mansions, Victoria Street, S.W.

Lineff Electric Traction and Lighting Syndicate, Limited.—The statutory return of this syndicate, made up to the 19th ult., was filed on the 1st inst. The nominal capital is £10,000, in £1 shares. 8,003 shares have been taken up, and are considered as fully paid. Registered office, 11, Queen Victoria Street.

London Electric Supply Corporation, Limited.—A notice was filed by this company on the 4th inst., stating that in accordance with a resolution passed on the 21st ult., the nominal capital of the company has been increased by the addition thereto of £250,000, in 50,000 shares of £5 each, beyond the registered capital of £1,000,000.

United Electrical Engineering Company, Limited.—The registered office of this company is now situated at 3, Prince's Mansions, Victoria Street.

CITY NOTES, REPORTS, MEETINGS, &c.

Electrical Automatic Delivery Box Company, Limited.

AN extraordinary general meeting of this company was held at the Cannon Street Hotel on Wednesday, Mr. A. H. Deakin presiding.

The notice convening the meeting having been read,

Mr. J. T. Evans, called upon by the chairman, read the report of the committee of investigation appointed at the last meeting and consisting of Major Murdoch, Mr. J. T. Evans and Mr. Otto Booth. The report was as follows:—"On the 18th of December, 1888, you appointed us as a committee to confer with the directors with respect to the management and working of the company, and we have accordingly had several conferences with the directors on the subject of the affairs of the company. We have also made enquiries as to the formation of the company, and have embodied the result of our enquiries in this report. We conclude by making certain recommendations. The company was incorporated in the month of February, 1888. It was promoted by the Contract and Agency Corporation, Limited. The prospectus discloses an agreement dated January 24th, 1888, whereby the intending shareholders are informed that the price to be paid for the purchase of the patent was £10,000 in cash and £20,000 in fully paid up shares. The company did not, however, acquire the patent by virtue of this agreement, but it was to be acquired subsequently to the company's incorporation by virtue of a contract dated January 9th, 1888, and the price to be paid to the company was the same, £30,000, of which £10,000 was to be in cash and £20,000 in shares. Of this amount £8,000 was to be paid to the patentees in cash and £2,000 in shares, and the residue was payable to the corporation, who alleged that out of the sum they had to make large payments of cash and transfers of shares. The company had paid the corporation in respect of the £10,000 cash £2,750, out of which the patentees had received £1,600, and in respect of the £20,000 shares have allotted 4,000 only. The prospectus was issued in the early part of February, 1888, and the allotment of shares took place on February 9th, 1888. The shares allotted in the whole amounted to about 13,970, but these included the 4,000 shares

allotted to the vendors and other shares which had been allotted to persons who were not able to pay anything in respect of the same. Therefore the total good allotment must be reduced to about 6,915 shares, on which 15s. per share has been called up, leaving an uncalled capital of about £1,700, and the cash in bank being about £1,500 and the calls in arrears which are recoverable amounting to £600, the company now has a working capital of about £3,500. As regards the management of the company, we find that the directors upon July 27th last entered into a written agreement with Mr. George Myers, appointing him manager of the company for three years at a salary of £300 per annum, payable monthly, and an additional commission of 5 per cent. on the trade receipts of the company until the same should amount to £200 in any one year. We are advised that this contract is binding upon the company and that its terms must be fulfilled. We are of opinion that Mr. George Myers might fulfil the duties of secretary as well as manager, and therefore we recommend that due notice should be given to the secretary of the company to terminate his engagement, it being understood that Mr. George Myers fulfils all his duties and is only to receive the salary fixed by the aforementioned contract. To this Mr. Myers consents. The salary of the secretary thus saved is 100 guineas per annum, and the secretary has accepted notice from the 8th inst. They are also of opinion that the company can dispense with part of its present offices, and notice to terminate the tenancy has accordingly been given. The articles of association provide for five directors, including the chairman, at a remuneration of £550 per annum. We hereinafter make proposals which will limit the directors to three only at a total remuneration of £175. The company having only paid to the corporation, as we have before stated, part of the cash and shares, and the corporation being now in liquidation, negotiations have been entered into with the official liquidator, Mr. Painter, and also with Messrs. Stead & Co., the patentees, for the reduction of the purchase-money, and the following is the result of these negotiations, embodied in an agreement to be signed subject to the approval of the court, the liquidator having no power, without such approval, to enter into such an agreement:—1. In regard to cash £2,750 has been paid to the vendors, as before stated, out of £10,000 cash originally agreed upon. No more cash is to be paid to any party. 2. In regard to the vendors' shares, of the 20,000 shares originally agreed upon to be paid to the vendors 4,000 were allotted, leaving a balance of 16,000 shares. This claim of 16,000 shares has now been reduced to about 3,600 shares in full satisfaction. The details are too intricate to be tabulated now. 3. Thus the original total purchase price for the patents of £30,000 will be reduced to a total of only £10,350. We recommend that the foregoing arrangements should be adopted and carried out by the company. With regard to the box we have had opportunities of consulting specialists, and in addition to the very satisfactory report by Mr. Ingrey, which was read at the general meeting of December 18th, we have ourselves minutely examined and tested the mechanism and working of the approved pattern box and are satisfied that, with the addition of the "rejector" referred to in the report, the machine is perfectly automatic and proof against being manipulated by any of the known artifices. Estimating the cost of each box at about £10, and allowing for cost of stock and working expenses, we find that a net profit per box of £10 per annum may reasonably be looked for, which, on 300 boxes, would yield some £3,000 cash income to meet dividends on £15,000 reduced capital and provide for directorate and office expenses. Your committee consider that not less than 100 boxes should be placed forthwith. Twelve of such boxes are now in a very advanced state. In order to carry out the affairs of the company to advantage and with economy, your committee consider it absolutely essential that there be three directors only, that their remuneration for the ensuing year be reduced by one half the present scale, that the new board consist of two new directors to be elected by the shareholders, and that these two be given the advantage of the assistance on the board of one of the two surviving directors of the old board, whose experience and knowledge of the history and details of the company from the date of its incorporation we consider indispensable. Mr. Deakin has consented to remain on the board, and we have much pleasure and every confidence in recommending his retention as director. Mr. Stead is desirous of nominating as one of the two new directors to be elected a Mr. Fisher, who is not a shareholder in the company; but for weighty reasons, your committee have not seen their way to including this among their recommendations. Mr. Stead consents to stand by the sense of the meeting on this head. The other surviving director of the board, Mr. Cooper, has, in a most generous manner, set free the hands of your committee on this point by voluntarily retiring. We have satisfied ourselves by examination of the records of the company and otherwise, that but for Mr. Cooper's protests and firm attitude at the board, large sums of money would have been paid away, and his attendances and services on the board since its formation in February, 1888, have been unremitting. During that period he has not drawn any of the fees to which he is legally entitled. We beg to recommend that, on his voluntary retirement, he be paid the sum of £50. Finally, your committee recommend that application should be made to the Court to dismiss the petition, and that being done, that the foregoing arrangements should be carried out. It will be necessary for the directors to use great economy and energy in the working of the company. We think then there is every probability of its affairs being brought to a successful issue, and we see no reason why the company should not be a dividend paying property. We cannot close our report without placing on record our sense of the readiness and cheerfulness with which the directors have placed at our disposal every possible facility for thorough examination and investigation of your committee."

The Chairman moved that this report be received and the recommendations therein contained adopted.

Mr. Brooker seconded.

Mr. Stead said he wished to move an amendment. He considered that the patentees, having sacrificed so much, ought at least to have their views taken into consideration. It was their wish to have Mr. Thomas Fisher, who would be duly qualified, upon the board, to look after the interests, not merely of the patentees, but of the shareholders generally. He thought it would be better to cut away all connection with the old board, who had done nothing. He implored them in March last to begin manufacturing boxes, even if they did not put them out. They said they were going to do so, but they did not. He respected Mr. Deakin very much, but he thought it would be better that none of the old board should remain, and that they should start afresh.

Mr. Hedgman seconded the resolution.

Major Murdoch said the main reasons why the committee had not seen their way to including Mr. Stead's suggestion among their recommendations were—first, that Mr. Fisher was not a shareholder, had never had any interest in the company, and never incurred any risk as the shareholders had; secondly, in the course of their investigations they had very clear illustration of the absolute necessity of the new directors having at their right hand one of the old directors who knew all the ins and outs of the various transactions of the company from the beginning. The third and last objection was this: The original proposition was that £60,000 should be obtained from all sources for the purposes of the company, and that half of that should go to the promoters, the vendors, leaving about £30,000 anticipated from the public. If the public had subscribed £30,000 the patentees would expect to get for their patent £10,000 in cash and £20,000 in shares; but, instead of £30,000 coming from the public, there was only an actual subscription from the public of under £7,000—that was to say, something like one-fifth of what was originally anticipated; therefore it was only right that the payment to the patentees should be one-fifth, or £2,000 in cash and £4,000 in shares. They had already received £1,600 for the box, and it appeared to the committee that the interests of the patentees had been very substantially represented in that transaction. The committee considered that there should be no antagonistic interests, but only one, the interest of the shareholders, represented on the board, and did not see their way to recommend that the nominee of the patentee should be elected.

The amendment was put to the meeting and lost, only three voting in favour of it. The resolution was carried.

The Chairman moved that Mr. Justice Kay be asked to dismiss the petition for winding-up the company presented by Messrs. Rushton, Trimmer and Thompson.

Mr. Jones seconded. Carried.

Mr. Sadler moved that, the present directors having resigned their seats at the board, Major Murdoch, Mr. J. T. Evans and Mr. A. H. Deakin be elected directors of the company.

Mr. Jones seconded. Carried.

A vote of thanks to the committee, moved by a gentleman who said he was the managing director of the Contract and Agency Corporation and had sustained a heavy loss in this company, but was willing to render every assistance in his power to the new directorate, was carried unanimously.

Major Murdoch, in replying, spoke highly of the box, which he thought was the Aaron's rod which would swallow up all the other rods, and said there was now every prospect of the company being brought to a successful issue.

The meeting then terminated.

"Pilsen-Joel" and General Electric Light Company, Limited.

AN extraordinary general meeting of this company was held at the Cannon Street Hotel, on Friday, the 4th inst., Sir Rawson W. Rawson, C.B., K.C.M.G., presiding.

The notice convening the meeting having been read,

The Chairman said the first business was to consider a resolution, of which notice had been given, to the effect that £100 each, free of income tax, be paid to Messrs. Scriven and Whately, in respect of their services as directors from the 11th December, 1886, to the 13th of March, 1888. Most of them would remember the circumstances under which those gentlemen, it having been shown to them that by an oversight they had ceased to be qualified, at once refunded the sums they had received for the period during which they were disqualified. He (the chairman) stated in the circular which he had occasion to issue immediately afterwards, and he repeated now, that he did not consider that they were either legally or morally bound to an act of that generous nature, and he hoped they would be recouped in due time. A shareholder had now come forward, at the last stage of their existence, being the opportune moment, to propose that the money should be refunded. He (the chairman) would have been quite prepared to move such a resolution himself, taking whatever obligation might be imposed upon him by so doing; but as Mr. Gwynne, who was the largest shareholder, had come forward to propose it, he should leave it to him to make the proposal, and he would be very happy to second it.

Mr. Gwynne said he had great pleasure in proposing "that £100, free of income tax, be paid to Horace William Scriven and George Levinge Whately, in respect of their services as directors of the company from the 11th of December, 1886, to the 13th of March, 1888." He had the greater pleasure, and felt the more justified in moving that resolution, inasmuch as the largest proportion of that sum would come out of what it would be his lot to receive from the company. Another reason why he was desirous of making the proposal was that, although he did not attend the meeting at which the directors were deprived of this money, he handed his proxy to another shareholder, who voted against them. When he (Mr. Gwynne) made an offer for the purchase of the company, and that offer was accepted, he openly stated that it was his intention that the first act of possession on his part should be to refund those gentlemen the sums they had handed back in respect of their fees. Therefore, he could with the more confidence get up now and say that in his opinion the shareholders ought unanimously, and without hesitation, to return that money. In fact, he should be inclined to go further, and say it should be returned with 5 per cent interest.

The Chairman seconded the resolution. He could not say now more than he had written and said before. Those gentlemen were perfectly unconscious of their position, and continued to do the work of the company; and, therefore, upon what ground they should seek to deprive them of what they fairly earned he failed to see.

Mr. Fyfe objected to this money being given on several grounds. In the first place, Messrs. Scriven and Whately were not directors of the company during the time for which it was originally paid, and secondly, they did not deserve to be paid because of their mismanagement. If they took the money, they ought to be held responsible for their culpable negligence in allowing the company's property to be wasted. If Mr. Gwynne was the largest shareholder, it was open to him, if he liked, to pay the whole of the sum out of his own pocket, but there was a large number of shareholders who did not feel any such obligation, and were strongly opposed to giving money to which the recipients were not entitled legally, or, in his opinion, morally. Mr. Fyfe continued to refer to charges which he said he had brought against the directors in a report by him to which no answer had been given, and enquired what had become of the stock sheets for the year 1884. He wished to read his report, but

Mr. Gwynne moved that the report be not heard. Every shareholder who was in any way interested had already seen it, and it would be irregular to read it now upon a motion to return money improperly taken from the directors.

The Chairman said he should object to its being read.

Mr. Fyfe: You are proposing to pay the company's money away, and I have proved in this report that it should not be given. It is the most shameless waste I have ever seen or heard of under the circumstances. You were doing a year's business of £733, and you want £200 for fees, which you were not even entitled to. We cannot afford to be so generous as to give that.

The Chairman: These gentlemen, sinners in the eyes of Mr. Fyfe and those who agree with him, have been twice re-elected since they gave up their money.

Mr. Fyfe: And they did exactly the opposite of what they were elected to do. They called up £3,000, and have spent it since.

Mr. Stobart protested against the payment for the simple reason that it was the only way they had of protesting against the gross mismanagement of the company. £50,000 or £60,000 had been wasted by those directors, and now they were asked to pay them £100, free of income tax. They had not taken sufficient interest in the company to see whether they were qualified to act as directors or not, and he thought they were not entitled to the money which it was now proposed to pay them.

The Chairman said Mr. Stobart's would be a fair argument if it were correct; but the fact was that the money to which he had alluded was spent, firstly, before Mr. Whately came on the board, and secondly, it was spent before the period for which it was proposed to pay them this £100, and whilst the company was under the management of Mr. Fyfe.

Mr. Fyfe denied that.

The Chairman: Most of the money, £25,000, was spent while Mr. Fyfe was manager.

Mr. Fyfe said he left value for the money. They had stock and patents and a going factory, which they foolishly pulled down, and they were suffering for that now. He left stock which they had allowed to become stolen and pawned, as was proved in Marylebone Police Court.

The Chairman denied that goods had been stolen and pawned. Goods had been sold to the best advantage.

Mr. Hutton objected to the payment on legal grounds. The resolution said "in respect of their services as directors," and they were not directors at all.

Mr. Parker, solicitor to the company, said they were not qualified as directors, but they did the work and for their services as directors it was proposed that they should have this sum of money.

Mr. Gwynne explained, for the benefit of shareholders who might not be aware of the fact, that the shares were reduced in value, and it was in consequence of this that Messrs. Whately and Scriven became disqualified. It was simply an accidental matter.

Major Scriven: We held double the qualification originally.

Mr. Fyfe once more complained that the directors had run down and ruined the company by misrepresentations, representing losses that were not made. It had been intended to give away the company's property three or four years ago, and it would have been done but for a protest from himself. A certain firm was to have had £500 a year for looking after the installations. He showed by the accounts that they were receiving £1,400 a year from installations alone. And for that he was called impracticable by Major Scriven.

The Chairman: And to that I add the epithet mythical. I do not know in the least what he means by talking about handing over the company for £500. However, nothing was to be gained by continuing the discussion and he would put the resolution.

The resolution was put to the meeting, with the result that five voted for and six against it.

The Chairman: Now we must consider the value of those votes.

Mr. Fyfe: In common decency don't do it, Sir Rawson. It will be shameful to do so.

Mr. Gwynne: I demand a poll. I suppose my shares alone outweigh all those against this resolution.

Mr. Brocklehurst said it was unseemly to demand a poll upon this resolution. On previous occasions resolutions had been moved and carried by the board and the matter was allowed to drop, no poll being demanded.

Mr. Gwynne said they had repeatedly had polls at meetings of the company.

Mr. Parker said if a poll was demanded by a shareholder the chairman had no option but to take it.

The poll was taken immediately. There were 8,102 votes recorded for the resolution and 1,010 against.

The Chairman therefore declared the resolution carried. The next business was the confirmation of the resolutions passed at the last meeting with respect to the winding up of the company. The first resolution was "That the company be wound up voluntarily under the provisions of the Companies Acts, 1862 to 1886." He moved that that resolution be confirmed.

Mr. Whately seconded.

Mr. Hutton proposed as an amendment that the words "under the supervision of the court," be added to the resolution. Serious charges had been made against the directors and the secretary, and these should be investigated.

Mr. Brocklehurst seconded.

The Chairman said that amendment could not be put. That was a meeting for confirmatory purposes, and they had only the choice of voting for or against the confirmation.

The resolution was carried by 10 votes to 4.

The Chairman moved the confirmation of the second resolution, "That George Shead, of No. 9, Laurence Pountney Hill, Cannon Street, in the City of London, chartered accountant, and William Henry Trentham, of No. 4, Stanhope Street, Euston Road, engineer, be and are hereby appointed joint liquidators for the purposes of such winding up."

This was seconded and carried.

The Chairman said that ended the business. He wished to say one word on the last occasion of their meeting, to thank them for the courtesy and kindness which he had always received from the shareholders and his colleagues on the board. He also wished to express to the shareholders, who were fellow-sufferers with him, his great regret that—he would maintain, not through the fault of the directors, but by reason of the course that had been pursued with regard to them—the company had landed in its present position, which was not different from that of most of the electric lighting companies, excepting that their loss was less than that of most others.

Mr. Gwynne attempted to explain the reasons why he had at an earlier stage of the company's existence entrusted Mr. Fyfe with his proxy and taken his cue from him, but frequent interruptions and recriminations from Mr. Fyfe precipitated a scene of some confusion, in the midst of which the chairman declared the meeting at an end.

Maxim-Weston Electric Company, Limited.

AN extraordinary general meeting of the Maxim-Weston Electric Company, Limited, was held on Monday at the Cannon Street Hotel, for the purpose of confirming the resolutions passed at the extraordinary general meeting held on December 21st last. Mr. John Marks occupied the chair.

Mr. Samuel J. Boyce, the secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, in moving the confirmation of the resolution just read by the secretary, I will draw your attention to one clause in the agreement which was read fully at the last meeting—every word was read fully at the last meeting, therefore I presume you know its contents. One clause provides that the new company have the power, by giving notice to the liquidators, to terminate the agreement, if dissentient shareholders, or shareholders holding 30,000 shares dissent from the reconstruction scheme. Well, now we know that great efforts are being made in certain quarters to induce shareholders to dissent from the reconstruction scheme, and those efforts are being made from interested motives. Mr. Abrahams at the last meeting told us that he represented shareholders holding 30,000 shares, and he should certainly dissent from the scheme. If shareholders holding 30,000 shares only dissent, I do not think that would be a bar to the new company carrying out this agreement with the liquidators; but if a very large number of shareholders dissent, I think then the new company would be justified in not carrying out the agreement, because to satisfy the gentlemen who dissented, the money of those who took up new shares would have to

be applied, and that would not be fair. I merely make these remarks to point out to you it is contrary to your interest to dissent from the scheme. It is all very well for Mr. Abrahams to tell us the liquidators will give 2s. a share to each dissentient. That is held out for the purpose of inducing you to dissent. We have a very different opinion. Suppose a very large number dissent and the new company did not go on with the scheme, what will be the position of dissentient shareholders, and also of those who do not dissent? It will be this, that the new company will drop the scheme, and the matter will fall into the hands of the liquidators; they will proceed with the liquidation pure and simple. What will the shareholders then get? I think if they get 3d. or 4d. a share they will be lucky. Therefore don't be deluded into the belief you will get 2s. a share by dissenting. It is merely placed before you for the purpose of damaging the company. I am sorry Mr. Abrahams is not here. I wanted to tell him, as representative of Mr. Hugh Watt, even if the scheme does not go through—and I cannot believe the shareholders will be so blind to their own interest as not to carry the scheme out—whatever is the result, the matters between this company and Mr. Watt, even if this company falls into the hands of the liquidators to be dealt with finally—the matters at issue between Mr. Watt and the company will be carried out by the liquidators just as if the new company was formed. I now formally move the confirmation of the following resolutions, viz.: "(1) That the liquidators of the company be, and they are hereby, authorised to consent to the registration of a new company, to be named the Maxim-Weston Electric Company, Limited, with a memorandum and articles of association which have already been prepared with the privity and approval of the directors of this company. (2) That the draft agreement submitted to this meeting, and expressed to be made between this company and its liquidators of the one part, and the Maxim-Weston Electric Company, Limited, of the other part be, and the same is hereby approved, and that the said liquidators be, and they are hereby authorised, pursuant to Section 161 of the Companies Act, 1862, to enter into an agreement with such new company (when incorporated) in the terms of the said draft, and to carry the same into effect with such, if any, modifications as they think expedient." The agreement is here, and open to the inspection of anyone who wishes to see it, and with your permission I will take it as read. It is a long document, and any gentleman who wishes to see it can do so.

Mr. Swaby: I beg to second the motion, and I thing I ought to say a few words. Several shareholders have begged that, if the scheme failed, we would endeavour in other ways to carry the company through. They are poor shareholders, and ask us to do all in our power. I must say the board has worked hard in your interest, and in your interest alone. I ask the support of every honest man to back us up.

Mr. Klenck: I may point out that this is our final scheme, and if you do not accept it the consequence will be the company will go into liquidation, and then you know the result—the selling of our patents and machinery, and everything we possess, and that will only give you a very small distribution. I think our chairman has taken a rather gloomy view of the situation. A threat is one thing, and a fact is another. We hold these proxies from the shareholders, who have sent us their support. We have not a single opposition in the office, and I think that ought to be made known to the shareholders generally, so that they may not follow in the footsteps of those who have interested motives in asking them to dissent from the scheme. If you are wise you will come into the scheme, and we shall be able in a very short time to put the Maxim-Weston on a sound commercial basis, a position we have not occupied for some considerable time in the past, but we hope to put the Maxim-Weston on a sound commercial basis, so that we may be able to take orders and execute them for the benefit of the shareholders.

The resolutions were then put and carried.

The Chairman: The forms of application for shares will be sent out in due course to each shareholder, and, as Mr. Klenck says, I hope we shall find the shareholders support us in the same manner as they have done in sending in their proxies.

A Shareholder: I would suggest that when the forms are sent out, a report of this meeting should be sent in order to show shareholders what their position will be if they dissent. Probably many may dissent, thinking they will get 2s. a share. They should understand that they will more probably get 2d.

The Chairman: I think that is a very good suggestion, to send out a *resumé* of what has taken place, and that we will do.

Mr. Klenck: Before you disperse, it ought to be known that two out of the three gentlemen who dissent from the scheme are two gentlemen who are in the office of Mr. Watt, so that you know where the opposition comes from. I thought it only right to communicate this to you unofficially, so that you may know what that opposition is worth. The number of shares held by the dissentients amounts altogether to 50 shares.

The proceedings then terminated.

Metropolitan Electric Supply Company, Limited.

AN extraordinary general meeting of the above company was held on Tuesday, for the purpose of considering, and, if thought fit, passing resolutions in accordance with the requirements of the Committee of the Stock Exchange altering the articles of association of the company. Alderman Sir R. N. Fowler, M.P., occupied the chair.

Mr. E. Cunliffe Owen (the secretary) having read the notice convening the meeting,

The Chairman said: These alterations are required by the Committee of the Stock Exchange. They are merely for the purpose of carrying out the stipulations of the Stock Exchange, and I will ask Mr. Burt to explain their purport.

Mr. Burt: Article 26 is the first of the proposed alterations. The article says:—"The share qualification of a director shall consist of his being a registered holder of 200 shares. A director may not act before acquiring his qualification." The Stock Exchange require these latter words to be struck out. The point is of no importance whatever in this company, because the directors have long since acquired their qualification. Article 45 is a limitation of the powers of borrowing of the company, which is also one of the new requirements of the Stock Exchange. Probably shareholders will think it reasonable. It is a recent requirement, by which in all cases they ask that powers of borrowing should be limited to some extent by the articles of association. Articles 45 was drawn in the old form without restriction, and it is proposed to add the words which are, in fact, a limitation to the amount of the share capital at the time being of the company. Article 102 is also one which is a modern requirement of the committee. It stood thus: "A director shall not be appointed auditor"; they ask it shall be altered: "No director or other officer of the company shall be appointed auditor." Of course, there was no intention of appointing anyone who is an officer. Article 119 restricts the lien on the shares to those which are fully paid. In Article 121 there is an alteration which provides that the transfer of shares shall be in the usual common form. In Article 123 they desire to insert the words "not fully paid-up." "Transfer of shares shall not be made to any person who shall not be approved by the board." The addition is "not fully paid up," so that a transfer may be made to any person if the shares are fully paid up. If they are not fully paid up it is necessary the board should have discretion, otherwise, if any company were in difficulties, and there was a sum unpaid on the shares, the holder of the shares might transfer them to a man of straw to escape his liability. In Article 130, which says, "Every original shareholder shall, on the original issue of the shares, be entitled to one certificate for each of his shares granted to him, but in every other case 1s. shall be paid," they require some alteration which is not of the slightest importance. In Article 155 the words come in again about not being fully paid up, and that applies to the lien also. It appears to be pretty much the same as in the previous clause. These are the only alterations. I think it will be convenient to take the resolutions *en bloc*.

The Chairman: Then I beg to move the following resolutions:—"That the articles of association of the company be altered as follows:—Article 26—By striking out the words 'A director may not act before acquiring his qualification.' Article 45—By adding at the end of this article the words 'Provided that the power of borrowing and raising money, and of making and issuing mortgages or debentures or debenture stock, obligations or other securities, shall not at any time, without the sanction of a general meeting, be exercised to such an extent that the total amount of principal money borrowed, raised or secured shall exceed the nominal amount of the share capital for the time being; but this restriction shall not oblige any person taking any mortgage or debenture, or debenture stock, obligation or other security of the company, to inquire whether there has been any such excess, or affect the validity of any such security in the hands of a *bonâ-fide* holder, nor interfere with the power of the directors to make and enforce calls.' Article 102—By striking out the words, 'A director shall not be appointed auditor,' and inserting in lieu thereof the words, 'No director or other officer of the company shall be appointed auditor. Article 119—By inserting after the word 'shares,' the words 'not fully paid.' Article 121—By inserting after the word 'writing' the words 'which may be in the usual common form.' Article 123—By inserting after the word 'share' the words 'not fully paid up.' Article 130—By striking out all the words except the words 'every shareholder shall be entitled to one certificate for his shares gratis, but in every other case one shilling shall, where the board think fit, be paid to the company for every certificate.' Article 155—By inserting after the word 'shares,' in line 2, the words 'not fully paid up.'"

Sir James Anderson seconded the motion, which was carried unanimously,

A vote of thanks to the chairman and directors then terminated the proceedings.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of December was 4,323 estimated to produce £3,600, against 3,925 messages, producing £3,373 in the corresponding month of last year. The traffic receipts for the month of September, estimated at £2,700, realised £2,774.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 4th, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,228.

The Great Northern Telegraph Company, Limited. The receipts for December, 1888, £22,000; January 1st to 31st December, 1888, £272,000; corresponding months 1887, £264,480; and of 1886, £258,600.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending December 31st are £4,475.

SIX YEARS' PRACTICAL EXPERIENCE WITH THE EDISON CHEMICAL METER.

By W. J. JENKS.

"MEASURE for measure" has ever been the underlying principle of the trade of the world. The mess of pottage for which Esau bartered his birthright was as truly in his eyes a recompense for the distinction and the patrimony with which he parted, as the property and the necessaries of life which we acquire are in our view an equivalent for the gold and silver which we pass from hand to hand in every-day exchange.

If we start out in life with the notion, so fondly cherished some time or other by every human heart, of getting something for nothing, we shall speedily realise the truth of what somebody has happily expressed in verse :—

> The motto of the world is "give and take,"
> It gives you favours—out of sheer good will.
> But unless speedy recompense you make,
> You'll find yourself presented with its bill.

We are not in business matters long contented with any system of guess work as to what the amount of the bill ought to be. Where values cannot be measured, we demand averages based upon long experience. Where it is possible to measure goods delivered, the ingenuity of man is untiring until some means is found adapted to the uses of all the traders of the world. It is only so far as we can draw from Nature's limitless supply of necessaries and blessings "without money and without price," that we fail to find in these days a meter check upon our consumption. As long as people live in civilised communities, water and artificial light will represent somebody's labour, and as they come to be more and more generally used, they must be more and more accurately measured.

Perhaps it has never occurred to many of us that about all the system of measurement that has ever quite satisfied mankind is the method or device by which we reckon the passage of time—which doesn't cost us anything. We look with suspicion on the scales of the butcher, and we don't believe the milkman's quart is more than two-thirds as large as it was years ago, though the price has advanced several per cent. When we buy dry goods we speculate on whether it isn't best to re-determine the length of a pendulum that will beat seconds at the level of the sea or establish a new yard on the metric basis, after we measure the distance from the equator to the poles again. We know by the ticking of the water meter that it is away off any standard, and last, and oftenest, we anathematise the gas meter, and the man that reads it, as being alike unsanctified.

Now, the electric current meter is a baby yet, but it is very likely to be considered by the great majority of mankind as a direct descendant of the gas meter—"a chip of the old block." Unfortunately, we cannot record directly the light or power really delivered from any source, and an approximation to such a record, through the measurement of the quantity of energy supplied, is an only practical alternative. The method which we shall examine to-night is, thus far, the only commercially successful means of measuring the energy delivered to electric lamps or motors. It is doubtless the first-born of a large family which will share in the stigma which the tribe of meters of all kinds has always borne. To show how far the stigma in this case is undeserved, and how much more accurately we can measure the mysterious intangible something, which we only know is a manifestation of energy, and which we call electricity, than we can the palpable forms of matter which are apparent to all the senses, is the purpose of this paper.

In the approximation which we make to the measurement of the light, heat, or power secured from gas we have three variables—quality of gas, rate of flow, and form of burner or method of consumption. In electrical work we eliminate at once the first and one of the most uncertain of these variable factors, for there is no difference, so far as we can discover, in the quality or commercial value of electrical energy from different sources, unless we change the method or the rate of its delivery (as, for instance, send it out in intermittent or alternating impulses).

So in order to arrive at a price at which we may profitably sell light or power we must know the electrical horse-power demanded by the translating device for a given result—that is, the efficiency of the lamp or motor and the energy actually delivered during the time of consumption. The work done or heat generated, which bears a definite relation (in a given type of lamp or motor) to the light or power produced, is expressed in three factors—pressure, current, flow, and time, and the product of these Joules or units of work accomplished in a given period is what we desire to measure. In the Edison system the light of the lamp and the speed of the motor are based upon the supply at their terminals of a constant pressure, and as the Edison meter is in its relation to the resistance of the circuit practically at the lamp or the motor, it may, for all commercial purposes, be regarded as always acted upon by the constant standard of E.M.F. applied to the device which transforms the electricity to the useful energy of light or motion. Hence we really make this a Joule meter, even while we drop the pressure which is a constant, and make it a measurer of current and time, or a coulomb meter. Its construction is based upon the fact that a given ampère flow will deposit a given weight of metal per second, and so knowing the weight of zinc deposited on a plate, it is easy to calculate the number of ampère seconds. In practice we take the hourly deposit (1,224 milligrammes of zinc by one ampère), and knowing the fraction of an ampère required for the standard lamp, we can readily arrive at the lamp-hours for which the customer should be charged. It is now becoming common to charge so much for an ampère-hour, and sometimes the price is the same whether supplied to lamps or motors, which are thus often included within the registration of one meter.

It is in a comprehensive system of house-to-house supply, where every unit of light or power is made separately controllable, that the necessity for such a meter appears most vital.

The records of the Patent Offices of almost all the civilised countries of the world bear witness to the fact that the method of connecting lamps, motors or similar translating devices in multiple arc (the only commercial method of attaining this individual control of current actuated by safe potentials) was original with Mr. Edison. But beyond this there is no question that we owe to him the first comprehensive conception of that form of multiple arc distribution which by combining a low resistance armature, a feeder system of transmission, and a high resistance lamp and motor, has made it possible for us to secure at all lamps and motors a marvellously close approximation to uniformity of pressure, and the expenditure of the largest economical percentage of the initial pressure in overcoming the resistance of the carbon filament or the motor armature, and thereby producing the greatest amount of useful work.

To Mr. Edison's view each detail of such a complete system appeared full of importance, and so we find him almost before he had a commercial lamp working on a meter by which each customer's consumption could be accurately determined, and which could be placed on his premises and inspected at such intervals as experience had shown was reasonable in the supply of the other measurable quantities, gas and water. He foresaw that it must not only be accurate, but cheap and durable. In his study of the subject he applied several principles of motion and registration, tried a great number of experiments with each, and secured several patents. Among them are the following :—

Fundamental Electric Motor Meter. Patent 242,901. Application filed March 3rd, 1881. This is an old example of a large class of meter inventions in which some kind of an electric motor, driven either by part or all of the current to be measured, is employed to overcome a fluid friction, but the claims cover broadly

the combination of a circuit, motor, fan, or other definite loading and registering apparatus.

No. 370,123. Patent applied for on April 17th, 1883. The form of motor here used is a development of "Sturgeon's Wheel," the wheel being transformed into a cylinder surrounding one pole of the magnet, itself being surrounded by the other pole. In this meter the indefinite friction is reduced to a very small factor, brushes are replaced by mercury contacts, and a very compact and simple form is possible. Probably if mercury did not have such a chronic disability to behave itself in practical continuous work, and if it really possessed the ideal character of a liquid which it commonly gets credit for, we would have seen this meter put into practical use by some one of the many inventors who have given it attention. This patent covers, among other things, the placing of the inductive portion in the direct circuit, and the fields in multiple arc therewith. A magnet in the main circuit closes the field circuit whenever the first lamp is attached, thus stopping the motor whenever the current flow is arrested.

Galvanometer Recorder. Patent, 307,030; application filed October 10th, 1883. This covers broadly a multiple arc circuit, a galvanometer in the main line, a circuit controlled by the needle, electrically operated apparatus in this circuit, and indicating or registering devices. Preference is given to a stylus recorder, the diagram made to be measured by a planimeter.

Recording Electro-Mechanical Meter. No. 293,435, applied for August 14th, 1882. This is a pivoted beam oscillated by electro-magnetic coils in the main or a shunt circuit, the rapidity of motion (regulated by air dashpots of large surface) being practically proportional to the strength of the current, The recording mechanism actuated by a local circuit operated by mercury contacts.

Fundamental Electrolytic Meter Patent. No. 251,545, application filed March 20th, 1880. This is the electrolytic meter according to the first Edison patent. An electro-magnetic cutout is claimed as part of the meter. The principal claim covers the use of an electrolytic cell placed in a shunt circuit, the resistances being so proportioned that a definite fraction of the current passes through the cell.

Recording Electrolytic Meter. No. 304,082, application filed August 14th, 1882. At the time of the Paris Exposition of 1881, the Edison meter was exhibited in the form of an automatically recording apparatus, two electrolytic cells being used, one plate of each suspended from the beam of a sensitive balance, the circuits being so arranged that one cell only is in circuit at a time, and the direction of current in that cell is such that the electrolytic action will throw the balance out of equilibrium, cause the beam to "kick," and by that action throw the current to the other cell, and register one on the counter. Whether this form was seriously intended for general use may be doubted; but it was very carefully worked up, several different forms patented, and it attracted a great deal of attention, and well deserved admiration in its time.

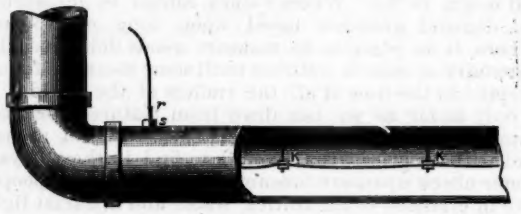
(To be continued.)

GAS MAINS AS ELECTRICAL CONDUITS.

WHILE it is quite probable that the idea of using gas mains as electrical conduits may have occurred to different people at various times, and especially since the question of getting rid of overhead wires has been so prominently before the public, says Wm. Maver, jun., in the *Electrical World*, it is more than likely that the first instance of the actual employment of those mains for that purpose is to be found in New York city.

About four years ago, when a new gas main was being laid between the gas works of the Consolidated Gas Company, of this city, at 99th Street and 111th Street, on the east side, which works were to jointly supply gas to the mains in that portion of the city, it occurred to Mr. W. H. Bradley, the engineer-in-chief of the company, that in order to secure uninterrupted telephonic communication between the works, which is necessary, it would be well to try the experiment of placing a conductor in one of the new mains connecting the two establishments. This idea was carried into effect, and a cotton-covered No. 14 B. W. G. copper wire was procured for the purpose. The experiment was from the first a decided success. A brief description of this novel arrangement may, therefore, be of interest.

The conductor enters the gas main in the sub-cellar of each building in the manner shown in the accompanying sketch, in which S is a "stuffing-box" of peculiar construction screwed tightly to the iron shell of the main. In the centre of the stuffing-box is passed a narrow glass tube, T, through which the wire enters the main. The glass tube is held firmly in position, and the stuffing-box is made gas-tight by the use of plaster of Paris. The wire itself is suspended by wires attached to the upper portion of the main, as shown to the right of the figure, in which a section of the main is removed for the purpose. The supports are insulated from the conductor by insulating knobs, K K.



This conductor, which has been in continuous service for over four years, has been, as already said, a perfect success. During the blizzard of last spring it was the only telephone circuit in the gas company's service that was not inoperative. The circuit being composed of but one wire is necessarily grounded at both ends. In length it is a little over half a mile.

Apparently the conductor is in as good electrical and mechanical condition to-day as it was when first placed in the main. On one occasion, when it was necessary to open a portion of the main traversed by the conductor, the latter was seen to be encrusted with naphthaline crystals to the extent of about 2 inches, but this, seemingly, had no detrimental effect on the conductor.

Encouraged by the success which has followed the original experiment, the same company has taken advantage of the construction of a new series of mains in the upper part of the city of New York to place in those mains over five miles of three-conductor lead-covered cable to be used in maintaining telephonic communication between the different offices, works and headquarters of the company. The cable comes out of the gas mains through stuffing-boxes at different points. The stuffing-box used in this case is somewhat similar to that already described. It consists of a hollow cup screwed into the shell of the gas main. Inside of the cup is a tubular glass insulator which screws loosely into the cup. The cable passes into the main through the glass insulator, and the spaces are filled with plaster of Paris. Inside the main, at intervals of about 12 feet, transverse boards are laid resting on the sides of the main. From these boards the lead-covered cable is suspended.

The officers of the company apprehend no detrimental action by the gas on the lead-covered cable.

Large Business.—Our electrical manufacturing firms may reasonably cast an envious eye on the work executed by some of the electric lighting companies in America. We read that the Thomson-Houston Electric Company has in hand, as new business or increase to existing installations, 3,600 incandescence lamps, and 1,505 arc lights.

THE ECONOMY OF ELECTRIC LOCOMOTION.

THE president and directors of the Danville Street Car Company, having operated a street car line for about one year with mule power, came to the conclusion that unless some more economical method could be introduced the venture would not prove one of much financial profit.

They had seven cars, which were drawn by mules, and the grades of their road were heavy and very long, and the result of these was soon apparent in the cost of maintaining the mules, and in the small receipts, which slow speed could only return.

After examining all systems and visiting electric roads in their own State, and having bids submitted by the various electric railway companies, they came to the conclusion that the Thomson-Houston system was the most substantial, durable and economical. A contract was therefore given to that company and work soon commenced. The entire length of the road is a little over two miles, and for 4,150 feet of this distance the ascent averages 4·3 per cent.; for 2,100 feet the ascent averages 5 per cent.; for 1,000 feet, 7 per cent., and for a short distance of this 1,000 feet stretch the grade exceeds 7½ per cent. Up these grades, which the electric car surmounts with ease, it was with difficulty that four mules could haul an ordinary load at a very slow speed.

The cars were equipped with motor trucks of 10 horse-power capacity, the controlling mechanism being concentrated at one end. The overhead system was built in the most thorough and substantial manner, according to the well-known admirable plan of the Thomson-Houston Electric Company. The road was started in operation on the 20th of November and has been in operation ever since. Four cars are daily run on a schedule which reduces their former mule schedule nearly 25 per cent. Since the road was started scarcely an electrical trouble has been experienced, and it has been the universal comment of the residents of Danville that their railway company has materially added to their welfare and comfort, and that they could not have selected a system which would have worked to any better satisfaction than the Thomson-Houston.

ON THE ABSOLUTE VACUUM AS A NON-CONDUCTOR OF ELECTRICITY, AND THE IMPORTANT BEARING OF THE FACT UPON ELECTRIC THEORIES.*

By DR. P. H. VANDER WEYDE.

THE historical exhibition which I furnished at the American Institute Fair of 1887 contained several series which for want of space could not be separately shown, as would have been desirable, if space had permitted. In fact, everything was to a great degree mixed up for the reason referred to.

Among these series, electricity in vacuo formed a prominent and important feature, and because this is a subject so little understood, and even misunderstood, by the majority of electricians, and is also neglected in the text books, I felt induced to take this for my subject, when I was requested to address the society.

An additional reason was that it is of some practical importance, not so much in regard to its mechanical applications, as for the understanding and explanation of a great number of natural phenomena.

I will treat the subject historically, and therefore begin by calling your attention to the experiments of Nollet, recorded in this little book, published in Paris, 1753, and illustrated with carefully engraved figures. His experiments consisted in passing a current of static electricity through glass flasks, from which a large portion of the air had been previously removed by the air pump. He found that the electric current passed as a luminous stream which was very bright when the room was darkened, while luminous pencils were thrown off toward the sides of the flask, if they were touched by the fingers, or any other conductor of electricity.

Some thirty years later a variation of this experiment was contrived, consisting of a strong glass tube of about two or three inches diameter and three or more feet long, provided with brass caps at each end, which could be conveniently attached to the air pump and exhausted. As the exhaustion proceeded, the rarefied air in the tube became a conductor of electricity, while this conductivity appeared to improve in proportion as the air was more exhausted. At last a regular stream of electricity was seen to pass through the tube, which stream resembled strikingly the luminous coloured streams seen in the aurora borealis, wherefore such a tube was called the "aurora tube," and under that name is found in most philosophical collections.

This apparatus was exhibited at the fair, the exhibit consisting of an old historical air pump, made about 1780, with the aurora tube screwed on the top of it. A few other smaller devices of a similar nature were less conspicuous, and about them I wish only to remark that, when using an ordinary air pump, it appeared that the conductivity of the air increased in proportion to the amount of exhaustion; hence the impression became prevalent that if we could only obtain a perfect vacuum we would have the best of all conductors, and this idea is, unfortunately, even at the present day, shared by several prominent electricians who have not had the opportunity to keep themselves posted in regard to the discoveries made during the last few years, especially those made by Crookes, Gassiot, Spottiswoode, Gordon and others.

I must not omit to mention that before the latter discoveries Geissler, in Germany, began to furnish investigators with a great variety of glass tubes of various fanciful shapes, made of different kinds of glass and filled with various gases and vapours, exhausted by the air pump or by being heated, and then sealed up by the blow pipe, while platinum or aluminum wires were inserted at the extreme ends, so as to conduct the electric current through the rarefied gases inside. As those tubes exhibited a series of striking and beautiful phenomena, they became very popular, and no physical collection is considered complete without a set of such tubes. They give occasion to exhibit the aurora phenomena, and similar ones of the same character without the trouble of continually working the air pump.

I had two sets of such tubes on exhibition at the fair; one was extra large, the tubes being three and four feet long, and another set of tubes as many inches in length, and which I shall have the pleasure to exhibit to you to-night, being much easier and safer to transport than large tubes.

I will now proceed to make a statement of the facts as they are. They are startling and difficult to explain without the knowledge of the new conceptions of Prof. Crookes regarding the nature of matter in the four different conditions, in which it presents itself to us.

The facts referred to are: The atmosphere in its ordinary condition is a very good non-conductor of electricity, provided it is perfectly dry and under a pressure equal to a mercurial barometric column of 760 millimetres or higher.

It is an important consideration, that if the air in which we live were a good conductor of electricity, man could never have become acquainted with electrical phenomena, as then static electricity could never have been collected, studied and experimented with; as this form of electricity was the key to the other different forms, the latter would never have been discovered.

When rarefied by the air pump to a quarter of the normal pressure, the insulating qualities of air are not so good, and when reduced to a pressure of 10 or 20 millimetres it is a good conductor and exhibits the phenomena referred to before. As this is about the limit attainable by an ordinary air pump, it is very natural that experimenters became possessed of the idea stated above, that the conductivity of the air would keep on increasing as the exhaustion proceeded, but after the Sprengel mercurial air pump was invented, by which the air can be exhausted to a thousandth of a millimetre of mercurial pressure (which is about equivalent to one-millionth part of ordinary atmospheric pressure), it was found that the capacity of the air to show the auroral phenomena in the usual way ceased.

The electric current then behaves in a very different manner, as it radiates in straight lines and cannot turn corners, so that when the tubes are bent it gives occasion to very striking and novel phenomena, which were first brought forward by Prof. Crookes in the tubes which are known by his name.

The difference between the Geissler tubes and the Crookes tubes is, that in the first the vacuum is very imperfect. In the Crookes tubes it is about a thousand times better, while if we succeed in making the vacuum a million times better, the conductivity of the air ceases absolutely. To accomplish this we must aid the function of the Sprengel air pump by some chemical device which will remove the last remnant of air. It then becomes an absolute non-conductor, which ordinary atmospheric air is not, because it is possible to pass currents of high tension in the form of an electric spark through the densest and dryest air. In the absolute vacuum, however, it is impossible to pass, over the space of a quarter inch, a spark which, when leaping through air, will be six or more inches long.

I exhibit here such a tube, in which the two platinum wires are brought together within a distance of scarcely a quarter inch. In this tube a vacuum did exist so perfect that it was impossible to pass a spark through, which through air would leap over a distance of more than six inches. I found that the spark would rather pass over the outside of the tube for that distance than go through the interior. In order to satisfy myself that no trace of electricity passed through the interior space of a quarter inch, I connected one of the platinum wires with a Leyden jar, wound a brass chain half way around the middle part of the tube, and connected this brass chain with the ground, in order to prevent any electricity from reaching the Leyden jar through the air along the outside,

* A paper read before the N. Y. Electrical Society.

but I was not able to obtain the least trace of a charge in the Leyden jar. Later I increased the strength of the current more and more, until at last something happened in the tube which destroyed the vacuum; something volatilised, covering the sides of the glass interior with a blackish deposit, which may perhaps be platinum black, a thing which may not be impossible, if we consider that the electric discharge furnishes us the highest temperature which we can possibly produce by any means.

For more than 20 years I have preached this non-conductibility of a perfect vacuum, as it was proved by experiments with the Ruhmkorff coil, by de la Rive and Du Moncel. The latter describes the experiments in his book "Sur l'appareil d'induction de Ruhmkorff," published in Paris about 25 years ago.

It has not a little surprised me that the priority of this discovery is so remote as I found it to be, and that so important a fact as that of the non-conducting power of a perfect vacuum has been overlooked and ignored for nearly a century after it was proved by experiment. I found in the *Philosophical Transactions* for 1785, page 272, vol. 75, the extract of a paper read by Morgan before the Royal Society, and which I published eight years ago in the *Practical American*, which I edited at that time. The paper referred to states that a mercurial gauge 15 inches long, filled with pure mercury which was boiled in the glass until all air was expelled, was coated with tin-foil 5 inches down from its sealed end, and was inverted into the mercury in a little trough, through a perforation in its brass cap; the air over the mercury in the trough was then exhausted, when the mercury in the gauge fell down more or less in proportion to this exhaustion, but had always a perfect vacuum over it. If then the tin-foil coating the upper end of the tube was connected with the conductor of an electric machine, not the smallest ray of light nor the slightest charge could be produced in this exhausted gauge; but if the mercury had been imperfectly boiled, coloured luminous phenomena were seen. The same was the case when the sealed end of a perfectly exhausted tube became cracked so that a little air had access. At first the electric charge passed with a yellow or green light; more air made the colour a beautiful green, then blue, from blue to indigo; more air still, violet and purple, until the medium became so dense as to no longer conduct electricity. The writer closes with the observation:—"I think there can be little doubt, from the above experiments, of the non-conductive power of a perfect vacuum. This seems to prove that there is a limit even in the rarefication of air, which sets bounds to its conducting power; or, in other words, that the particles of air may be so far separated from each other as no longer to be able to transmit electricity; that if they are brought to within a certain distance of each other, their conducting power begins, and continually increases, till their approach also arrives at the limit."

It is also a fact, known for more than a century by expert barometer makers, that the luminosity which shows itself in the dark in its vacuum, when a barometer is moved up or down in order to cause the mercurial column to oscillate in the same way, is only seen when the mercury has been boiled in the tube to a moderate degree; when the vacuum is made too perfect it shows itself feebly, or not at all, the same as is the case when the vacuum is contaminated with watery vapours.

So much for facts; now for the theory which explains them, and for which we are indebted to Prof. Crookes. It gives us an inside view of the nature of matter in the conditions in which it presents itself to us, and is based on the theory of Dalton, that all matter consists of an immense number of infinitesimal particles, called atoms, which are indestructible, and in continual motion, which latter is also indestructible.

Astronomy teaches that in the planetary system we find a condition of things which is far beyond our ordinary conception based on our experience about things falling under the daily, immediate observation of our senses. First, the distances at which the celestial objects are placed are immense in proportion to their size, stupendous as it appears to us. Secondly, they are in a continuous motion, which is indestructible. Every planetary system is to us a perfect "perpetuum mobile."

Modern chemistry teaches the same doctrine in regard to ultimate atoms, which constitute that which we call matter. First, the distances of these atoms are also very large, in proportion to their size, which is infinitesimally small beyond our conception; secondly, these small particles or atoms are also in a continuous everlasting motion, as indestructible as is the motion of the planetary bodies.

As a concise statement of the modern philosophical conceptions in regard to this subject, we say that, as the chemists of the past century proved, that apparent destruction of matter was only a transmutation of form, so the physicists of the present century have proved that apparent destruction of motion is also merely a transmutation of form, a change in the mode of motion; mass motion changed into molecular motion, which reveals itself as heat, light, or electricity, or, *vice versa*, any of the latter forces into one another or into mass motion. Of this transformation the steam engine and the modern dynamo are forcible illustrations.

The great Swedish chemist Berzelius more than half a century ago expressed similar views, when he declared that the heat and light we see in an electric discharge, say, in a stroke of lightning, is not the electricity itself; he states most explicitly that the restoration of the electrical equilibrium, which when destroyed gives rise to what we call electrical phenomena, causes the evolution of sudden light and heat in the bodies through whose medium this restoration of equilibrium takes place, which light and heat then radiates and diffuses itself according to the ordinary well known laws of radiation and convection.

Crookes, in order to explain the peculiar behaviour of electric discharges through his highly exhausted tubes, teaches the doctrine that our conception of three states of matters, solid, liquid and gaseous, is incomplete; he says that there is a fourth condition, which he calls radiant matter. He teaches as follows:—

In solid bodies the atoms are in a state of rest; that is to say, as far as their relative position is concerned, but each atom oscillates to a greater or lesser degree. If the amplitude of the oscillation is small, we call the body cold; if the amplitude of the oscillation is large, we call the body hot; and, in so far, Crookes's theory agrees with what Tyndall has popularised in his well known work, entitled, "Heat as a Mode of Motion."

When the amplitude of the oscillations becomes so great that the atoms turn over and commence to rotate around their centres, the body reaches its melting point and becomes a liquid. Therefore, in liquids the atoms are not rigidly fixed to certain positions, but can freely roll over one another, and this constitutes the difference between solids and liquids.

When the velocity of the rotation becomes greater and greater, we say that the liquid is becoming hotter, and when from some cause or other this motion is still further increased, a new set of phenomena begins. The atoms are projected into space, and in place of rotating they are propelled from the liquid, and also repel one another, and as millions upon millions exist in the small space of a cubic inch, collisions take place by billions, and the body enters in what we call the "gaseous" condition.

Here we have entered a field for the conception of which very few are prepared. We are as little prepared for it as our ancestors were when Galileo and Copernicus, and later, Herschel, revealed to mankind the immensity of the universe. When at school, studying astronomy, we obtained some kind of conception of the infinitely large.

We are not yet educated to the conception of the infinitely small, which is a new revelation, which is as difficult to grasp with our finite mind as it is to grasp the infinitely large. In considering the latter, we speak of distances so great that our common measures are utterly inadequate, and we must have recourse to larger standards of measures, such as the velocity of light connected with the time it takes to reach us from the most distant stars, which, in some cases, has been proved to be ten thousand years.

In considering the motion of the atoms of gaseous matter, we enter the other extreme of the conception of great and small. It appears that the number of atoms in one cubic inch of the common air we breathe is represented by a series of more than twenty figures, which particles or atoms are in constant continual collision to the number of ten million per second, while the velocity is so great that, if moving in a straight line, they would pass through a space of eleven thousand feet in a single second, thus surpassing the velocity of sound ten times. This is the nature of the third or gaseous condition.

The fourth condition, attained by the Sprengel air pump, is called by Crookes radiant matter. It is reached when the exhaustion proceeds so far that there are so few atoms left as to make the collisions exceptional; then the atoms will move in straight lines, and encountering no mutual hindrance to their motion, they will follow the laws of electric repulsion, and *radiate* from the point charged with electricity; hence matter in this condition is called "radiant matter."

Now we come to the most interesting feature of our consideration, namely, the chemical device referred to above, and intended to remove this last trace of air; recourse is had to the strong chemical affinity of potash for carbonic acid. The exhausted tube is filled with carbonic acid gas and again exhausted, and this process repeated in order to make sure that no atmospheric gas is left, but only very rarefied carbonic acid gas. A recess is connected with the tube during the operation, in which recess is placed a small stick of pure caustic potash. This recess is heated by a spirit lamp, so as to drive out the carbonic acid which the potash may contain, and then the vacuum is again made. The last remnant of carbonic acid which the air pump cannot remove is then absorbed by the potash, when this is allowed to cool down. In this way the absolute vacuum is produced, through which no electric current can be made to pass.*

The bearing of this fact is of the utmost importance in regard to our conception of the nature of electricity. It is generally admitted that the theory of the existence of a caloric fluid is erroneous, and that heat is merely a peculiar mode of motion, as referred to above, and this view is adopted, notwithstanding there is no experiment known serving to demonstrate that heat cannot be transmitted through a space absolutely devoid of all matter. Heat and light will both pass through a vacuum perfect enough to obstruct absolutely the passage of electricity. If there were such a thing as an electric fluid, it surely would pass through any empty space, and we are therefore driven to the conclusion that the presence of matter is as absolute a condition for the transmission of electricity as the presence of air is an absolute condition for the transmission of sound; and there is as little necessity to accept the hypothesis of the existence of an electric fluid as there is for the hypothesis of a sonorous or caloric fluid.

* Of the accompanying two cuts, fig. 1 represents an arrangement, similar to the tube exhibited at the lecture, while fig. 2 shows that as the direction of the magnetic needle may be deviated by a wire conducting an electric current, *vice versâ*, the direction of a flow of an electric current in a partial vacuum will be affected by magnetic influence, as shown by the results of charging and discharging the electro-magnet seen below the tube.

Air being the ordinary vehicle by which sonorous vibrations are transmitted, a proper degree of exhaustion will arrest this transmission, and any common air pump can be made to prove that sound is with difficulty transmitted through a partial vacuum, and not at all when the vacuum is somewhat nearer to perfection. This experiment is acknowledged to be intended for a demonstration that the air molecules are the media for transmitting sound; that without such a medium there can be no sound, and that there exists no peculiar sonorous imponderable fluid which pervades the air, and should be the cause of sound transmission. When now we see that more highly rarefied air behaves toward electricity in exactly the same way as the lesser rarefied air behaves toward sound, namely, that at a certain degree of rarefaction the transmission becomes more imperfect, and at a certain point stops entirely, we are driven to the conclusion that electricity as well as sound is merely a peculiar form of motion of ponderable matter.

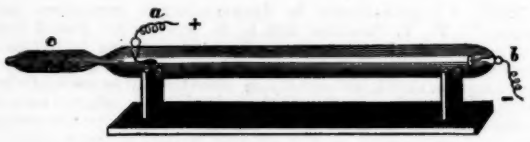


FIG. 1.

The conventional method of calling electricity a fluid must be understood to be only for the sake of convenience in explaining the phenomena presented. An argument in favour of this custom is that electric currents behave like water in two respects, namely, moving under greater or smaller pressure and in greater or smaller quantities.

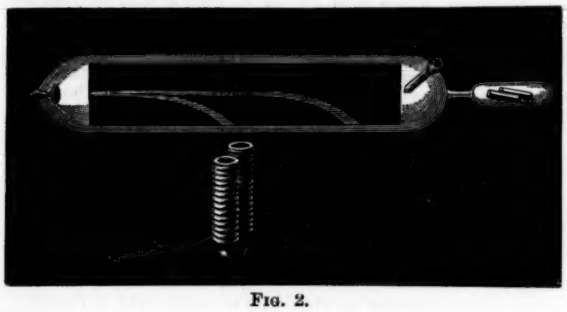


FIG. 2.

What in water is called pressure or head is in electricity called electromotive force, and as hydraulic pressure can overcome great mechanical resistances so electromotive force overcomes great electrical resistances.

It is measured by a standard unit, which is properly called after the illustrious Italian who first invented an apparatus which multiplied the small electromotive force of a galvanic couple, the column of Volta. The quantity of electricity discharged through a channel is measured by another standard, also very appropriately named after the great French investigator, Ampère, who discovered the laws governing the mutual action and reaction of currents of great quantity.

That rarefied air is by no means so good a conductor as assumed by many, is proved by the fact that it requires a considerable electromotive force to pass it through. Machines producing static electricity, either by friction or induction, give that high electromotive force, while a single large galvanic cell, or better still, a thermo-electric couple, offers the other extreme, viz., a large quantity of very low electromotive force, utterly incapable of being transmitted through any kind of vacuum.

I referred in the beginning of this paper to the application of the knowledge recently obtained in regard to the behaviour of electricity in rarefied air and in vacuo for the purpose of explaining certain natural phenomena. These phenomena are principally the aurora borealis and australis, and especially those which are related to the immense enigmas which from time to time appear in the heavens, the comets, which alarm the ignorant. On a future occasion I hope to have the satisfaction to show you that all the peculiarities presented in both cases may be satisfactorily accounted for by the lately discovered facts to which I have called your attention to-night.

THE "ELECTRIC" SUGAR PROCESS.

THE following trade circular by Messrs. Willett and Hamlen, eminent authorities on sugar in the United States, issued shortly before the exposure of the fraud, shows, says the *Financial News*, how thoroughly the most competent experts were hoodwinked, and shows also the foundation there is for assuming that there may be something of value in the process though the "electric" pretence has been exposed :—

"Since our last circular several trials of sugar-making have occurred, at which we have been present. At one such, on the 3rd and 4th inst., 23,753 lbs. net of raw sugar were used in the secret room. This sugar analysed as follows : cane, 94·70 ; grape, 1·14 ; water, 1·84 ; ash, 0·43 ; organic substances, 1·89 ; total, 100. This sugar was delivered in half-bags for convenience of handling. The machinery was started, and inside of ten minutes refined sugar began to appear two stories below, and continued until 79 barrels were filled, which weighed 22,341 lbs. net. The running time, not counting intervals, was 217 minutes, or at the rate of one barrel every 2¼ minutes. The operators were two women and six men. By listening at the wall of the secret room, the emptying of each bag of sugar into the crushing machine could be plainly noted by the loud and distinctively peculiar noise coming from any crushing machine when the material to be crushed enters it, followed by a more quiet interval of sound between each bag. This recurrence of sound continued during the running. Nothing more could be noted on that floor except that the serious vibrations of the building indicated machinery of great power. On the floor below the 'granulators' could be distinctly heard as they manipulated the sugar and sent it down through the spouts in regular short 'puffs' of much force. Water was evidently convenient to the 'granulators,' as an overflow of it came down through the floor at one time, and the moist condition of the sugar at times, and dryness at other times, show that water was being used unevenly, or that the sugar was allowed to descend before sufficiently dried. Many times a handful of the large grades would divide into fine sugar under a gentle pressure, as if it had just previously been built up from fine sugar by some process, but it would not cake in the hand after so divided, and in a few minutes the moist sugars would become dry and firm in their several grades. At other times we have seen the sugar become thoroughly dry, and with pulverised sugar dust escaping into the room and covering one's clothes. All the sugar, in whatever shape or condition it comes, we have found to be a different crystal and with different characteristics from any refined sugar made in the United States, to our knowledge, on examination without or with the microscope. We cannot conceive that this sugar is produced from ordinary loaf or crushed sugar ground and sifted. We noted decided evidence against such a theory. It cannot be made from imported refined sugar of any description, for the importations of such sugar into the United States for the past two years are less than the amount of sugar thus far made by the Electric. We find that the raw sugar used as above contained 95·84 per cent. of saccharine (cane and grape), and that 94·05 per cent. of refined was produced, showing that all the cane and grape were turned into refined, except, say, 1·8 per cent. If this was a guess in output of refined, it was a remarkably good one, as at the conclusion of the run the unused part of the raw sugar was delivered back from the secret room, and the correct weights of raw and refined, as given above, ascertained. An analysis of electric sugar gave cane 99·80, grape 20, water none, ash none. An analysis of old process hard refined sugar shows a mere trace of grape. No syrup, or indications of it, appeared anywhere. No heat or smell is in the building, such as would be perceptible if a vacuum pan was ever in use. The sugar always comes out cold. In fact, everything visible, and one's impression of the invisible are such as to be almost as convincing as would be a sight of the secret rooms and the entire process. The prestidigitateur produces from the secret room, or hat, an egg, which everybody recognises at once as the counterpart of all eggs produced by all hens ; but the Electric give out from their secret room a sugar which nobody recognises to have ever seen before, which contains by analysis what none other contains, which is an entirely different crystal, and which crystals join themselves together, as it were, by

touch only, and not solidly, as in the melting process. This process claims to be a new discovery, combining chemical, mechanical and electrical action, not merely electrical, as many suppose, and condemn it on this ground. We do not know how much longer the secret will be confined to the secret rooms, but we expect to greet the 'new process' to the light of day whenever the company are ready and willing, and shall not be surprised to find it all it claims to be."

CONTRACTORS' ELECTRICAL SUPPLIES.

THE Woodhouse & Rawson Electric Supply Company of Great Britain has just published a second edition of its catalogue of such electrical supplies as are used by central station electricians, contractors and others. The new issue is not by any means a mere reprint of the first but bears evidence of an amount of careful elaboration and improvement highly creditable to the compilers. To compare the present catalogue with its predecessors is to read the history during the last few years of the development of the electrical industry. For instance, in the section devoted to engines the new matter in the present publication includes descriptions of the Armington-Sims, the Westinghouse, the Beck (gas), and the Spiel (petroleum) all of which have in the meantime been establishing themselves as amongst the best of their kind for electric lighting purposes. Then, again, with respect to dynamos, we find the additions include the Brush, the Norwich, described as the cheapest of its kind, the Alliance, the Phœnix, and the Mordey-Victoria alternator, thus indicating the machines which are most distinctly asserting themselves as meeting the current demand. With regard to incandescent lamps what the new edition says is that the W. & R. lamp has never been beaten on its merits, but that it has not been supplied in England for nearly two years owing to legal difficulties which are now overcome so far that the lamps can be obtained, the makers giving a guarantee. The only novelty in this section is the Sunbeam lamp, which has had such a prosperous career since it was first shown at the Newcastle Exhibition. The notable additions to the arc lamps described are the Brush, recommended for its extreme simplicity of construction, and the Brockie-Pell, described as the perfection of an arc lamp, both electrically and mechanically. So great is now the variety of fittings, that it is only possible in a publication of this kind to give a few illustrations of such things as brackets, pendants, electroliers, and shades, but such as are given show that a great deal of attention has been of late devoted to the designing of such requirements, resulting in considerable improvement. As to switches, Messrs. Woodhouse and Rawson claim to be the largest manufacturers in the world, their many improvements being covered by numerous patents. They make over 150 different types, and time having tried all these, we may conclude that those which are dealt with in the list have come scathless through the ordeal. Not only in the directions we have named, but all through the book may be traced the progress of electrical business, and even in a more marked degree is it to be seen in the entirely new subjects now treated of for the first time, such as portable electric light plant, search light plant, electric pumps, tramcars, launches and submarine boats, photometrical and wire testing instruments, and secondary generators or converters. Special chapters are also given to series traction and telpherage. The preface states that the object of the publishers has been to make the book the most complete of its kind in the trade, and we think it will be generally conceded that this has been accomplished, and we cordially join them in the hope that the industry will have made such progress by the close of the present year that it will by that time be necessary to issue another edition, in order to keep pace with the times. The book consists of 284 pages, and is illustrated by over 250 woodcuts. Compiling, illustrating, arranging, editing and printing are all praiseworthy; in fact, we have failed, after a somewhat careful perusal, to discover even a misprint. We believe the credit of this is due to Mr. Sydney Rentall, who has had the personal responsibility of preparing the work for publication, and who has evidently acted on the principle that what is worth doing at all is worth doing well.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

12676. "Improvements in dynamo-electric generators and motors." W. T. GOOLDEN and L. B. ATKINSON. Dated September 19. 8d. The invention consists in applying to dynamo-electric generators, or motors, a casing or covering, preferably of non-magnetic metal, and which may conveniently be made of wire gauze. The casing starting at the pole pieces, or magnet bars, is continuous with the pedestals carrying the shaft, or the casing may be so constructed as to form the carriers of the brushes in which the shaft revolves. The claims are 3 in number.

15217. "Improvements in measuring alternating currents of electricity." W. LOWRIE, C. J. HALL and H. W. KOLLE. Dated November 8. 8d. Consists in differentiating the wave of potential so that there is a slight preponderance upon one side of the neutral line over the other. The difference of potential is available for doing the work of measurement, either by mechanical means or by chemical action. The differentiation may be produced by the introduction of an intermittent current acting upon the pulsations of the main current in such a manner that the potential in one direction of the main current is slightly higher than the potential acting in the other direction; or by a retarding influence or resistance opposing the main current in one direction only; or by the introduction of a constant electromotive force into the circuit, acting to reinforce the potential wave of the main current in one direction and to retard it in the opposite direction. The differentiation can be effected by various means; and it may originate in the alternating current generating machine itself; or in a device or devices outside of, or exterior to, the generating apparatus, and acting upon the flow of the current. When produced by exterior means, the differentiation may be accomplished by a dynamo machine; by a primary or secondary battery; or by other means resulting in the desired manner. The claims are 12 in number.

15878A. "New or improved apparatus for measuring the time during which a current of electricity or other fluid is flowing." V. POPP. Dated November 18. 6d. Claim:—An apparatus for recording the duration of flow of an electric or other current, comprising pneumatic clockwork and a closing device permitting the passage of the compressed air only when the electric or other current is flowing, substantially as described with reference to the drawings.

16790. "Improvements in dynamo-electric machines." S. C. HANBERG. Dated December 6. 6d. The horse-shoe magnet is made from one piece or of several layers parallel to the plane of the curve, and the foot or base plate is so placed as to connect noncontrary magnet poles with each other in general, therefore, at any place either on the north pole—or south pole—shoe. The coiling of the bobbin on the machine, although the magnet spool is not detachable, as it is cast or forged together with the poles, is rendered possible by the use of but one magnet spool, which is arranged opposite to the free space for the armature between the poles on the part connecting the two poles, being at the same time not, or only slightly, broader than the minimum distance between the poles. The whole magnet may, therefore, for winding the bobbin, be so secured on a rotating disc, that the axis of the bobbin coincides, or approximately coincides, with the axis of rotation, so that the wire meets no obstacle in the winding. The claims are 2 in number.

16807. "Improvements in or connected with incandescent electric lamps." D. URQUHART. Dated December 6. 8d. The inventor supports a contact which completes the circuit to the lamp by means of the lamp glass or enclosing glass, a spring or springs constantly tending to break the contact, but being prevented from so doing by the glass. On the glass being fractured it no longer prevents the spring or springs from breaking the contact, and consequently it or they immediately act to extinguish the lamp. The claims are 3 in number.

17231. "Improvements in means for the distribution of electricity." H. EDMUNDS. Dated December 14. 8d. Relates to the use of a "motor generator," that is, an apparatus or device combining means for obtaining motion from the common circuit, and means for generating or converting the motion into a current for utilisation at the required place. The claims are 5 in number.

17502. "Improvements in electricity meters, parts of which improvements are applicable to dynamo electric generators and motors." G. HOOKHAM. Dated December 20. 8d. The inventor constructs meters for measuring electric energy by causing the current to be metered, or a portion of it to pass either through the armature or field-magnets of a suitable electro-motor while the

field-magnets or armature (as the case may be) are placed upon a shunt circuit in such a way as to give a field proportional to the electromotive force. On the axis of this electro-motor is mounted a disc of copper, or other suitable metal which moves in a constant magnetic field, and offers resistance to the rotation of the electro-motor by virtue of the eddy-currents generated in it. The claims are 4 in number.

17582. "Apparatus for indicating the time during which electricity is used for lighting or other purposes." E. F. H. H. LAUCKERT. Dated December 21. 8d. Claim:—Apparatus for indicating the time during which electricity is used, the said apparatus consisting of clockwork driving electro-magnetic clutches which engage and move indices while electrical currents pass through coils that excite the magnetism of the clutches, but which become disengaged when the currents cease, substantially as described.

1888.

208. "Improvements in the utilisation of waste products from electrical batteries." O. C. D. ROSS. Dated January 5. 6d. Claims:—1. The application and use of the waste products of electrical batteries in preparing or enriching artificial or mineral manures formed from phosphates of lime, bones, salts, gypsum, lime, and analogous materials, substantially as described. 2. The application and use of such waste products as aforesaid as contain nitrogen, for fertilising purposes, substantially as described. 3. The application and use of such waste products as aforesaid as contain nitrogen, in the preparation of superphosphates, substantially as and for the purposes described.

295. "A new or improved electric meter." T. PARKER and E. REES. Dated January 7. 8d. The inventors employ the heating effect of an electrical current to evaporate a fluid contained within vessels carried upon the periphery of a disc or wheel or the equivalent thereto. The heating effect is confined or limited to a segment upon one side of the wheel, and so arranged that the evaporation shall be proportional to the current; the remainder of the wheel and the vessels thereon are exposed to the atmospheric temperature. The interiors of the vessels are connected so that as evaporation takes place the vapour may pass from the heated vessels to the cool ones, where it is condensed. From the displacement of the fluid from one to the other side of the wheel, disc, or its equivalent, it follows that a rotation of the wheel will be set up, and since the rapidity of rotation depends upon the greater or less intensity of the evaporative or heating effect, which is proportional to the current, it follows that the rate of rotation will also be proportional to the current. The current, therefore, may be measured, registered, recorded, and indicated by means of the motion of rotation of the disc or wheel which operates well known devices ordinarily used for similar purposes. The claims are 2 in number.

302. "A new or improved electric meter." T. PARKER. Dated January 7. 8d. The inventor employs two metallic thermometers connected in opposition to each other by a pivoted rod in such a manner that any variation of temperature to which both thermometers are equally exposed will give no motion to the rod, but so also that if one thermometer is exposed to a greater or less temperature than the other motion will be imparted to the rod. This arrangement eliminates any disturbing effect of varying atmospheric temperature to which both the thermometers may be exposed. One of the thermometers is exposed to the heating effect of a current of electricity in a coil of wire or in a conductor forming part of an electrical circuit so that any variation in the current will produce a variation in the heating effect which will correspondingly influence that thermometer and produce angular motion of the pivotted bar connected thereto. Upon the rod a pawl is pinned and arranged so as to be capable of engaging with the teeth of a ratchet wheel. If, therefore, the rod is depressed or moved to its zero position at regular intervals, angular motions in one direction are given to the ratchet wheel, and each of these angular motions will be proportionate to the current during that interval. If also, the teeth of the ratchet wheel are graduated to represent ampères and the rod is depressed at one minute intervals the number of teeth occupying the angle through which the wheel moves will equal ampère-minutes of current. The rod is depressed by clockwork and by preference by means of an electrically driven clock so as to obviate the necessity for rewinding. The motion of the wheel is transmitted by suitable apparatus to devices for registering, indicating or recording the values of the current. The claims are 2 in number.

705. "A mouthpiece to be attached to the transmitter of the telephone." L. E. PERCY. Dated January 17. 8d. Consists of a new mouthpiece to be attached to the transmitter of the telephone, whereby the effect of the sounds which are required to be transmitted through its agency are intensified. The apparatus comprising this new attachment is constructed substantially in the following manner. A barrel or drum of vulcanite, brass, or other suitable material, of such size as to fit the transmitter of the telephone, open at both ends, and larger in the centre than at the ends, is provided internally with a conical piece of such diameter that a small space is left between the exterior of the said cone and the interior surface of the drum, the cone being fitted inside the drum by means of small projections or arms at its base, and lying therein with its base towards the telephone. The apex of this cone is thus in such a position that the vocal or other sounds pass around it and between the surfaces of the cone and the drum, and the waves of sound striking the interior surface of the drum at a certain angle, and are deflected into the transmitter of the telephone at a corresponding angle, and condensed at a central point upon the electric diaphragm or otherwise. There is 1 claim.

729. "Improvements in electric batteries and elements therefor." D. URQUHART. Dated January 17. 6d. Claims:—1. In or for electric batteries the manufacture from peroxide of lead of plates or elements by bringing the peroxide into intimate contact by means of an aqueous fluid or solution with ammonia, or equivalent reducing agent, which will produce a slow chemical change in the peroxide whereby it is caused to "set," and thus becomes a permanently coherent mass, substantially as described. 2. In or for electric batteries treating the plates or elements formed of peroxide of lead and produced as described with a solution of oxide of lead in caustic alkali, substantially as and for the purpose described. 3. The manufacture of plates or elements for electric batteries by treating peroxide of lead with ammonia or with the solution of an alkaline sulphide, and subsequently with an alkaline solution, substantially as described. 4. The manufacture of plates or elements for electric batteries by combining peroxide of lead, or both peroxide of lead and monoxide of lead with sulphide or sulphite of lead, with or without the addition of magnesia, substantially as described. 5. In or for electric batteries the means for making contact between the elements and the conductors, consisting of an elastic fitting piece pressing platinum foil in contact with the interior of the element, the said platinum foil being connected to the conductors, substantially as described.

12396. "Improvements in electric motors for self-winding clocks." W. P. THOMPSON. (A communication from abroad by D. W. Edgecomb, of America.) Dated August 28. 8d. Consists in dispensing with the usual dog or locking pawl applied to the clock movement, and applying to the motor itself a device which arrests the armature drum in any of one or more predetermined positions when its current has ceased. This consists of a lever or detent which may be thrown into the path of the armature when the latter commences to revolve backward. This detent is so located with reference to the electro-magnets of the motor, that when arrested the armature drum shall stand in such a position that a forward movement will be insured upon the next completion of the circuit. The claims are 4 in number.

12437. "Improvements in electrical conductors or cables." W. A. CONNER and J. W. MARSH. Dated August 29. 8d. Claims:—1. An electric cable or conductor, having a number of spirally-arranged insulated conductors, each conductor having a cross-section greater in breadth than in thickness, substantially as described. 2. An electric cable or conductor, having one or more central conductors or cores, and a number of insulated conductors arranged spirally in one or more circles around the central conductor or core, and each conductor forming in cross-section a segment of a ring or circle. 3. An electric cable, having a central conductor or core, and a number of insulated conductors arranged spirally around the central conductor, and each having a cross-section greater in breadth than thickness, and composed of a number of naked wires or ribbons, substantially as described.

12986. "An improved electric or galvanic sponge or pad for stimulating and curative purposes." R. CRESSWELL. Dated September 8. 6d. Claims:—1. The combination of a sponge or pad with the battery, formed of plates of dissimilar metals devoid of angles, and the excitant moistened with a solution of acid or salt and glycerine, and the India-rubber strip, as explained and set forth. 2. In a galvanic or electric sponge or pad, the use of an exterior label or mark denoting the approximate power of the battery within the sponge or pad.

13128. "Improvements in electric railway signalling systems." J. IRWIN. Dated September 11. 8d. The object of this invention is to provide an electric apparatus whereby a moving train will transmit signals back to the starting station as it reaches each intermediate station to indicate its position on the road, and whereby the train will also transit signals ahead of it from station to station as it advances, and thereby prevent collisions. The claims are 4 in number.

CORRESPONDENCE.

The "Maxim-Weston" and "House-to-House" Companies.

As many of your readers are aware, I have just succeeded (after three years of unremitting efforts) in inducing my fellow citizens to introduce the electric light into Bath for public and private use, and have obtained from the Corporation a seven years' contract (on behalf of a local supply company) for the public lighting of fifty of the principal streets, squares, and crescents of this city with arc lamps. Plant will shortly be put down for 200 arcs and 10,000 incandescents.

I am not, as many suppose, a professional electrical

engineer, but only an enthusistic admirer of the "light of the future." During the past four years I have unstintingly spent my own time and capital in introducing electricity into several towns in the West of England, in the prosperity of which I am personally interested.

To my surprise, just as we are on the eve of forming our local company, the "House-to-House" make an application to the Bath City Council, asking them to sanction their applying to the Board of Trade for a licence for lighting the same area for the same term of years. What is the meaning of this application? Is the "House-to-House" Company imitating the behaviour of the "Maxim-Weston" Company when under the chairmanship of Mr. Hugh Watt, M.P.? The unjustifiable interference of the "Maxim-Weston" some twelve months ago, just as the Commissioners of Sewers were contemplating entering into a contract with the Brush Corporation for the lighting of the city, was not only a loss to that particular company, but still more so to the whole of the electric lighting industry. The only effect of this application is to frighten a certain number of timid investors, who will be afraid to apply for shares in the Bath Electric Lighting Company if labouring under the mistaken impression that it is going to be subjected to the competition of a powerful London company, with an unlimited amount of capital behind it.

Even if the "House-to-House" possessed the necessary capital to erect a large central station, they would obtain no custom, as they could not compete with the local company, except at a ruinous loss. The sooner companies which pursue this "dog-in-the-manger" policy cease to exist the better it will be for the electric lighting industry, the growth of which they retard by their short-sighted policy.

I trust that this candid expression of my views may produce beneficial results.

H. G. Massingham.

A Protest.

We have noticed in your last issue a letter signed S. Sudworth, which evidently refers to our firm and catalogue, and in answer thereto we can only state that the assertions made therein are fabrications from beginning to end. At the same time we wish to mention that Mr. E. L. Berry, whose name was referred to by Mr. Sudworth, has written to us saying that the letter was published without his knowledge or authority.

G. Binswanger & Co.
H. HIRST.

January 7th, 1889.

A Correction.

You were good enough to insert a letter of mine in the REVIEW last week; but my name attached, perhaps through my indistinct signature, is wrongly read —it is not "Samuel" (although that is a good name), but

James C. Richardson.

January 7th, 1889.

Underground Mains.

With reference to the very timely articles published on various occasions recently in your valuable paper regarding underground electric light cables, may I remark that one of the greatest points to be looked into by the electric lighting engineer is the actual insulation resistance, when laid, of his underground main. Let us be guided in this by the submarine telegraph companies. When they order a cable, it is with the full knowledge that capital is being risked to the extent of the value of that cable, and they accordingly take every human precaution to render the risk as small as possible, which is precisely what the lighting companies are *not* doing. They spend money to the necessary extent in providing sufficient copper to carry the required current, without losing H.P. in heat, and they cover this with an insulator; so far good. But having done this, they take the tender core and illtreat it in almost every conceivable way. To remedy this requires a larger outlay in first cost of manufacture, and far more skill and care in laying, and above all, efficient supervision by really reliable consulting engineers. What is the good of being careful up to a certain point, and then undoing what so much pains have been taken to do? A submarine cable is considered to be *core* through the whole of its manufacture, up to the time of sheathing; great care is taken of this core, although the copper conductor, with a weight per mile of only 150 lbs., has a heavy coating of gutta-percha on it, covered with one, two, or three tapes, *and* with two servings of strong jute. An underground electric light main is considered to be equivalent to a 3-inch iron pipe, as far as capabilities of enduring "nasty knocks" is concerned, with probably a copper conductor of 11,000 pounds weight per mile, covered with a scant insulation vastly disproportionate to the diameter of the conductor; and this *core*, far more tender than the submarine one mentioned above, has one or two paltry tapes, a braid of thin hemp or jute licked over with pitch, and is sent out to the contractor for laying, with no record of its insulation test, to be put underground, in many cases with greater chances of injury than the well-protected submarine cable which lies lightly and easily on the ocean bottom with absolutely no chance of disturbance in deep water. The deduction to be drawn from my comparison is obvious. The company ordering cable to be laid underground, and therefore out of sight, must have the best possible workmanship put into that cable under efficient supervision, and as much precaution must be taken as is done in submarine work, and the insulation must be such as to agree with the specific insulation of the material decided upon as the dielectric; until this is done we shall have endless trouble with underground systems, and all money spent in mains will be risked unnecessarily.

Thorough.

Institution of Electrical Engineers.

I think the leaderette in the issue of December 28th was very much to the point. It is noticed with wonder by some how it happens that many of our best men on the practical and commercial side of electrical work have no interest in, and are never seen at, the meetings of the (late) society. There are one or two whose names will occur to everyone connected with the trade, notably, our most advanced central station engineer, and two of our foremost electric traction engineers. As we now aspire to the position of an "Institution," could not some communication be sent to those whose work is well known, so that their attention might be drawn to the advantages of membership? One other point might be altered with advantage, and that is the conditions of entrance for students. As they are at present, there is no proof of the would-be student's capabilities, or of the good his joining will do him or the society. We might copy the Inst. C.E. in this matter, and thus progress.

C. H Yeaman.

"A New Form of Condenser"

Allow me to tell you that the "Trefoil-condenser," described by Mr. Perren-Maycock in your number of January 4th, page 24, is not new. In your issue of March 14th, 1885, you gave an extract of a paper of mine, which appeared in the "Archives Nierlandaises," in which the same form of condenser, to which I gave the name of Triangle-condenser, was described.

J. W. Giltay.

Delft, *January 6th*, 1889.